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Evolution of safety glass

by A. F. RANDOLPH*

PETRONIUS reports that in the days of the hard-headed Emperor Tiberius a certain Roman glass-maker succeeded in producing a glass vessel which could be bounced around upon a stone pavement without being broken, and that the unfortunate inventor was straightway sent off to the executioner, for the sound economic reason that the wise Tiberius feared that the further development of so wonderful a new material would depreciate the value of his imperial hoard of gold.[1] Apparently an early case of the suppression of an invention—and a rather complete suppression of the inventor also.

During the Victorian era the great German chemist G. W. A. Kahlbaum (1853–1905) is reputed to have astonished his companions in a Swiss Bierstube by exhibiting an "unbreakable beer-glass." But this was made, not of glass, but of an acrylic resin.[7]

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Early history

The first effort to make glass panes "unbreakable" was apparently that of one Newton, in England, about 1855, who endeavored to embed wire in glass. But not until the last decade of the nineteenth century was wire-glass successfully made on a commercial scale, by Siemens in Germany and by Shumann in the United States.[4] The embedment of wire netting in sheet glass served to hold the latter together when cracked by a blow or by the heat of a fire, and wire-glass soon attained widespread use, chiefly in industrial structures.

Cracked but still intact, the broken windowshield below graphically demonstrates the stretchability and toughness of the polyvinyl plastic interlayer in Hi-test safety glass. A rock thrown by the tire of a passing truck struck and shattered the glass but both rock and broken particles adhered to the plastic, thus preventing injury to the driver. Interior (1) and exterior (2) views of the cab show the stone in its plastic nest, hours after the accident occurred

PHOTOS, COURTESY LIBBY-OWENS-FORD GLASS CO.

But it appears never to have been used in vehicles, except in a special form utilized in Stutz cars about fifteen years ago.

In wire-glass lay the germ of the idea of laminated safety glass as we know it today. And gradually one inventor after another came closer to the final concept of two sheets of glass held together by a tough, transparent intermediate layer. Thus one Wade, in 1899, proposed a sight-glass into which a perforated sheet of mica would be fused.[11] In 1902 it was proposed by Street to strengthen glass battery jars, so that they would hold together if cracked, by coating them with pyroxylin plastics.[12]

Laminated safety glass, with an interlayer of plastic, was first visualized, it appears, by John Crewe Wood, a solicitor living in the market town of Swindon in southern England. His application for patent in 1905[13] states the matter very clearly:

"My invention relates to improvements in transparent screens and windows for motor cars and other vehicles, and has for its object the prevention of injury to occupants of such cars and vehicles through pieces of glass striking them if by accident such screens or windows should be broken, the pieces of broken glass in my invention adhering to the screen and not becoming detached.... To the above end my invention consists in providing two sheets of glass between which is fixed or cemented a sheet or film of any transparent adhesive substance or material with sufficient elasticity to prevent splintering when broken and provide an agglutination or hanging together of the parts. For example, I employ a sheet of celluloid between two sheets of glass or a film of a substance such as gelatin or other transparent substance less brittle than glass and not liable to splinter."

There seems to be no "human interest" story connected with Wood's invention, but another inventor of this same period gives quite a dramatic account of his own independent evolution of the idea.

This man, Edouard Benedictus (1879–1930), of Paris, was nothing so prosaic as a solicitor, and identified himself in his patent applications as an "artistic painter." He was, moreover, a poet, a philosopher and a musician, and reputedly a descendant of the philosopher Baruch (Benedictus) Spinoza.[5] His account[6] of his discovery, given twenty years or so after the fact, contains romantic Gallic elements.

"One day in 1903, as I was setting my laboratory to rights, and moving the glassware around, a bottle slipped from my hands and fell to the floor from a considerable height. This bottle, of about one liter size, I picked up apparently unbroken. The glass was

3—Here is the old method of manufacturing safety-glass interlayer by the block process. The sheets sliced from the block are piled on the shelf above the carriage of the sheeter. Modern methods of safety glass manufacture are pictured here. 4—A solvent-recovery still recovers by-products from manufacture of polyvinyl butyral resin, a basis of new safety-glass interlayer

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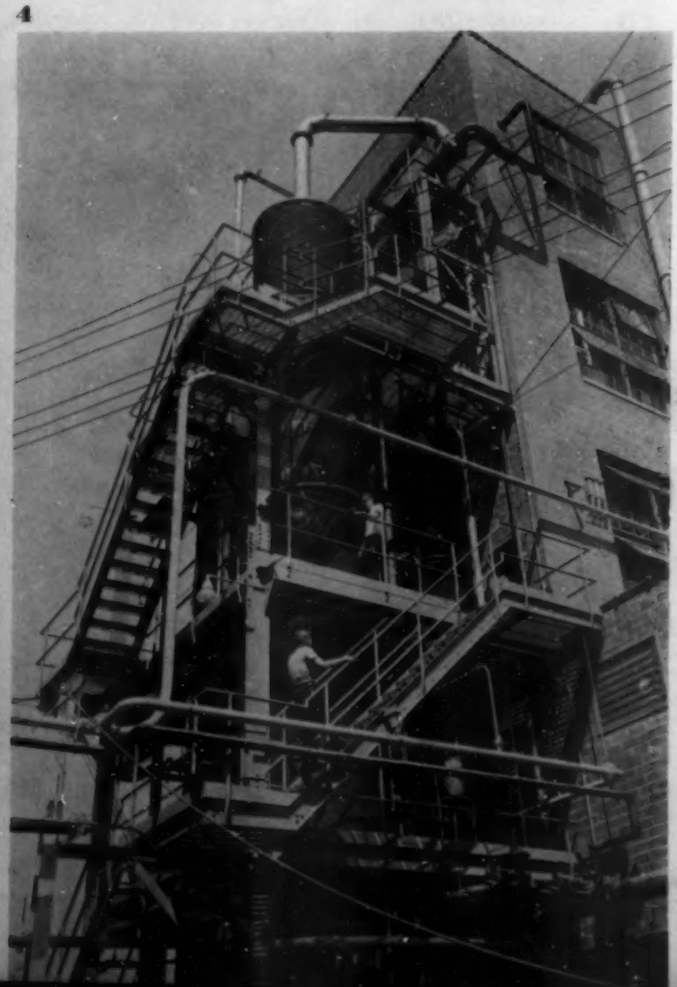

starred like Bohemian crystal but was held firmly together by some internal adhesion.

"The bottle had contained a solution of nitrocellulose, from which, over a period of fifteen years, all of the solvents had evaporated, thus lining the interior of the bottle with a celluloidal coating of great strength. So firmly were the fragments of glass held by this layer that not a single piece of any size became detached or even loosened. Having made a thorough examination of all parts of the bottle, I attached to it a label reading 'November 1903—this flask fell from a height of 3.5 meters, was picked up in its present condition.'

"I replaced the bottle on its shelf and thought no more about it until one day when my attention had been attracted by two accidents caused by the breaking of glass in vehicles. Two young women suffered lacerations of the neck in collisions.

"I was sitting after my dinner thinking intently of these two accidents, when suddenly, without warning of any sort, there appeared upon the wall, faintly illuminated, and moving as though alive, the image of my bottle. Emerging from my reverie, I rose to my feet, entered my laboratory, and gave myself up to deliberate contemplation of the possibilities of this embryo of an idea which had come to me from my bottle. At dawn the next morning I found myself still with the bottle in my hand, not having stirred for nine hours, but with a program of experimentation drawn up, which I proceeded to carry out step by step.

"By the next evening, with the aid of a letterpress, I had prepared the first sheet of Triplex glass, complete in all its characteristics and its promise for the future."

The date of this experiment is uncertain, but it was in 1909 that Benedictus applied for patents and founded the Société du Verre Triplex. The Triplex Safety Glass Co., Ltd., was formed in England in 1912, and found some outlet for its products in military equipment during the war which began two years later. But in Europe, as well as in this country, during this period, there was little steady demand for safety glass. The protective value of the composite pane was admitted, but the subject seemed hardly of more than academic interest. The automobile was still in its infancy. Cars were few in number, speeds were low, and accidents comparatively uncommon, and the cost of safety glass seemed prohibitive. The manufacturers of pyroxylin plastics were definitely interested in the possibilities of this new outlet for their sheeting, which was the only material which met the general requirements of an interlayer for the glass sandwich, but there was no immediate prospect of any business at the time, so little action took place in the field. (*Please turn to next page*)

5—The vinyl acetal resin is shown at the factory being packed in strong steel drums as it comes from the dryers. **6**—In the manufacture of the safety-glass interlayer, the material is extruded through a slit orifice to form continuous sheeting which is immediately chilled to hold its shape. The sheeting is carried through a rapid and effective seasoning process for removal of volatile solvents

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PHOTOS, COURTESY E. I. DU PONT DE NEMOURS & CO., INC.

7 PHOTOS ON THIS SPREAD, PITTSBURGH PLATE GLASS CO. AND LIBBY-OWENS-FORD-GLASS CO. 8

7—Prior to laminating, sheets of glass cut to shape are laid in pairs on a conveyor. 8—Later a sheet of plastic of the same shape is laid on one piece of glass and the other is placed on top where they are washed to form the sandwich. This assembly is then ready for the preliminary bonding by pressure before being laminated into safety glass

The experience of the Arlington plant of the du Pont Company during this period is probably typical. In the United States, one or two comparatively small companies were turning out safety glass on a small scale and were using, as the interlayer sheet, the same transparent pyroxylin plastic which was currently used in the side-curtains of automobiles. In 1917, the business in safety glass interlayer was only a small fraction of that in the same sheeting for side-curtains. But safety-glass sheeting became at this time a major problem to the research staff.

First difficulties

The chief trouble was that the plastic discolored badly when exposed to sunlight. A second difficulty lay in the unprecedented requirement that the sheeting be seasoned to a lower solvent content than had been found necessary in its other applications. Complaints on both scores sometimes arose in a single shipment. In fact, the difficulty with discoloration first came to the attention of the research department when a customer, seeking to remove residual solvent, spread some sheeting outdoors in sunlight, and found it developed a pink discoloration.

Studies made at this time demonstrated that certain of the heavy metals contributed to the discoloration of the plastic by sunlight. Chiefly important was iron,[14] which was found to be present in unexpectedy large proportions in the plastic, having its origin in the cellulose, in the water used for purifying the pyroxylin, and also in the equipment used in the manufacture of the plastic. To correct this condition by means then known would have required expenditures far beyond what could have been justified by the volume of business in safety-glass sheeting. Fortunately, however, the principal safety-glass customer of that period, who strongly objected to pink discoloration in sunlight, was not particularly disturbed by a yellow discoloration, and the discovery that certain so-called color-stabilizers, added to the plastic, would cause the discoloration to be less intense, and invariably yellow instead of pink, furnished an economical temporary solution.

At about this same time (1917–1918) the industry was selling also a fair quantity of transparent pyroxylin plastic sheeting for the manufacture of laminated goggles for gas masks. Here the chronic complaint related to seasoning, and one customer adopted a seasoning treatment, devised by himself, in which

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9—After preliminary "setting," panes of safety glass are placed in tubs, piled one upon the other, and lowered into an autoclave (10) filled with hot liquid in which hydraulic pressure unites the two panes of glass and plastic interlayer into one safety glass pane. The plastic becomes completely transparent in this process

(believe it or not) the cellulose nitrate sheeting was heated by close proximity to a gas flame.

Up to this time no serious attention had been given to the cloudiness or haziness of this flatteringly so-called transparent sheeting, but it was not long before research departments were called upon to improve the material in this respect also. This demand came not specifically in connection with safety-glass interlayer, for safety glass was making very little headway, but chiefly from the fact that automobiles themselves were being rapidly improved from year to year, and the public was becoming correspondingly more critical, so that the deficiencies of the sheeting used in side-curtains of open cars were more clearly recognized.

Transparent sheeting for side-curtains had come to be a large item of production, and the volume of business was ample to carry the expense of research directed at bettering its quality. As a result of an intensive study, considerable improvement in clearness was effected, through elimination of the more obvious causes of haze. But before the research job had been carried really to completion, the improvements effected were found sufficient to satisfy the trade and the public, and the study was discontinued.

Research in modern safety glass begins

The rapid acceleration of the production of automobiles in the 'twenties brought little comfort to the manufacturers of pyroxylin plastics, for the trend from open to closed cars developed even more rapidly, so that the number of open cars manufactured was actually decreasing, and with it the business in sheeting for side-curtains. The only hope for a revival of business in transparent sheeting seemed to lie in a general acceptance of safety glass as a necessity rather than a luxury in the autombobile. Any approach to universal adoption of safety glass, even in windshields alone, would bring back the lost volume of business in transparent sheeting, and considerable additional volume.

Actually such a state of affairs was brought nearer by the increasing number of accidents with automobiles, resulting from the enormous increase of the number of cars on the roads, the higher speeds at which people were beginning to operate their cars, the inadequacy of many highways, and kindred causes. At this period it was stated that two-thirds of all personal injuries in automobile accidents involved broken glass. In jest it was being said that if an accident involving disfigurement by glass were to happen to a movie queen or

11 PHOTOS, PITTSBURGH PLATE GLASS CO. 12

11—At this machine, the operator smoothes the edges of a safety-glass windshield pane by grinding. **12**—The polyvinyl interlayer in this window extends beyond the edges of the glass making a rubber-like rim which can be bolted, nailed or screwed to a window frame for aircraft or automobiles. The outer edge forms a gasket-like seal, airtight even if glass is broken

some other prominent public character, the resulting publicity would create a public demand for safety glass and hasten its general adoption. But it was not until nearly the end of the 'twenties that safety glass came to be offered generally, as optional equipment, in the windshields of automobiles. Subsequently, of course, it became adopted as standard equipment in windshields, and thereafter in windows as well.

The beginning of the widespread use of safety glass in automobiles was the occasion for the resumption of intensive research to overcome once and for all the shortcomings of pyroxylin interlayer sheeting. For, in spite of the good protection offered by the product, its previously recognized defects had never been fully corrected, and others which had passed unnoticed came to be recognized now, as manufacturers of safety glass and of automobiles developed a more comprehensive familiarity with the requirements of the product.

The old trouble with discoloration was still a problem, in spite of improvements made during the preceding decade in the manufacture of pyroxylin. The producers of refined chemical cellulose, particularly from cotton linters, for use in nitrating, had greatly improved this raw material, and beneficial changes had been developed in the procedures of nitration, stabilization and purification. The resulting improvements in the stability of the pyroxylin had made it feasible to reduce the amount of urea incorporated into the plastic as stabilizer, and this reduction had a beneficial effect on light-stability, for, as was now recognized, urea was a contributing factor in the discoloration of pyroxylin plastic by sunlight.

But in this period of renewed activity and research upon safety-glass interlayer, namely, about 1928 to 1930, haze was found to be a very much more serious problem than discoloration. In the earlier days of very limited use of safety glass, haze had passed unnoticed, because automobile headlights were feeble and because the unimproved roads of the earlier period kept a windshield so coated with dust that haze in the interlayer was not recognized. But at this later period the manufacturers of automobiles, and the driving public also, had become fully aware of the annoyance and hazard of a windshield which is milky when illuminated by street lamps or approaching headlights.

Surprisingly, it was found that haze in pyroxylin plastics was due primarily not to cellulosic matter nor to miscellaneous dirt, but chiefly to iron. In spite of improvements already made, following the recognition of the role of iron in discoloration, an objectionable quantity of iron was still to be found in the pyroxylin, chiefly as the result of adsorption from the water used in its stabilization and purification, and additional quantities of iron were being introduced by contact of the plastic with steel equipment in the course of its manufacture. It was found also that, regardless of the source of the iron, the mere mechanical manipulation of the plastic dough in mixing and rolling caused an

increase in haze by altering in some manner the particle size or the chemical consitution of the iron compounds present. With iron thus recognized as the important cause of both discoloration and haze, improvements in both light-stability and transparency were effected by refinements in equipment and procedure designed to reduce still further the iron content of the plastic. The principal steps taken were the exclusion of iron and ordinary steel from equipment coming in contact with the pyroxylin or with the dough, and improvements in the quality of the water used in the purification of the pyroxylin.

Another important defect of pyroxylin plastic at this period went under the poetical but fairly descriptive name of "star-dust." Whereas haze in the plastic was made up of an infinity of particles of sub-microscopic dimensions, star-dust was visible to the eye as individual particles capable of reflecting light, like bits of a dust in a sunbeam. Star-dust, which was just as annoying as haze in night driving, was shown to be of cellulosic character, and to result from non-uniformity of nitration or from contamination of pyroxylin with unnitrated cellulose dust in the nitrating house. Appropriate modifications in preparing the cellulose for nitration and in the procedure of nitration, together with improvements in housekeeping in the nitrating house, were successful in overcoming this serious trouble.

The high standards of appearance and uniformity which had come to be demanded made necessary much stricter care than had previously been exercised to prevent contamination of the plastic during the several steps of its manufacture. Also, for the successful prosecution of research work and the establishment of effective controls in the manufacture of the improved product, various special instruments were developed or adapted. The former rather inaccurate measurement of haze by comparison with arbitrary standards was replaced by optical instruments giving numerical readings. A projection machine was developed for the magnification of areas of sheeting under inspection for star-dust. Black velvet-lined boxes fitted with concealed quartz-mercury lamps and used in a darkened room facilitated inspection of transparent sheeting.[10]

Manufacturing methods

The ultimate general adoption of safety glass in automobiles necessitated plans for providing increased manufacturing facilities for the production of the interlayer sheeting. This in turn stimulated thought in the direction of devising a simpler, less expensive and more generally satisfactory technique of manufacture.

The traditional block method of manufacture of pyroxylin plastic is well adapted to the manufacture of a large variety of differently colored materials, and of materials of different thicknesses, in comparatively small quantities, but for the production of safety-glass interlayer sheeting, in large quantities, of a single composition and a single thickness, it had certain recognized disadvantages. The block method produces individual sheets of fixed size, from which windshield and window sizes cannot be cut economically. Furthermore, it was recognized, as already mentioned, that haze is accentuated by kneading operations essential to the block process, and the operation of rolling, in particular, is not only rather expensive but also furnishes opportunity for contamination and the development of certain other defects.

With the incentives of economy and improvement in quality, experimental work was carried forward on a new technique, and resulted in the development by the plastics industry of equipment and methods for the manufacture of safety glass sheeting in continuous form by extrusion. The development of the new technique passed from laboratory experiment through elaborate semi-works installations to the construction of manufacturing units, and subsequently of more, successively larger and improved, manufacturing units. Today practically no safety-glass sheeting is made by the block process.

The technique of production by extrusion involves, successively, the steps of mixing the ingredients to form a dough, filtering this dough, and then extruding it, by application of pressure, through a slit orifice to form continuous sheeting, which is immediately chilled so that it will hold its shape, and finally carrying the continuous sheeting through a rapid and effective seasoning process for the removal of volatile solvents.

Pyroxylin interlayers

Pyroxylin plastic produced by this method was found to be superior, for safety-glass interlayer, to that produced by the block process, because a more thorough filtering was made possible by the somewhat softer condition of the dough, and because the processing, carried out in a closed system, gave no opportunity for contamination by foreign material, and also because the method involved less severe kneading of the dough and hence less development of haze as a result of kneading. The extrusion process has the further advantages that it costs less per pound of finished product and that the continuous sheeting which it produces is more economically handled and shipped, and more advantageously cut to size, than the individual sheets of fixed size produced by the block process. The extrusion process, originally developed for the production of interlayer sheeting made from pyroxylin, has been adapted to the manufacture of other sheetings which have subsequently displaced it.

The pyroxylin plastic interlayer possessed certain admitted characteristic defects, chief of which were its tendency to become discolored and impaired in toughness by prolonged exposure to sunlight, and its partial loss of toughness and cohesiveness at winter temperatures, which impaired its protective characteristics.

Cellulose acetate interlayers

The first interlayer material to compete with pyroxylin sheeting was that of cellulose acetate, which is com-

paratively little affected by prolonged exposure to sunshine. Considerable research was involved in the development of a satisfactory cellulose acetate interlayer, since it was necessary to improve the quality of the cellulose acetate flake in order to reduce to an acceptable level its content of haze and of star-dust, to find a suitable plasticizer for it, and to solve the problem of providing a strong and permanent bond between the cellulose acetate interlayer and the glass.

Cellulose acetate began to displace pyroxylin for safety-glass interlayer in about 1933, and by 1939 had almost completely eliminated pyroxylin from this use.

Properties desired in safety glass

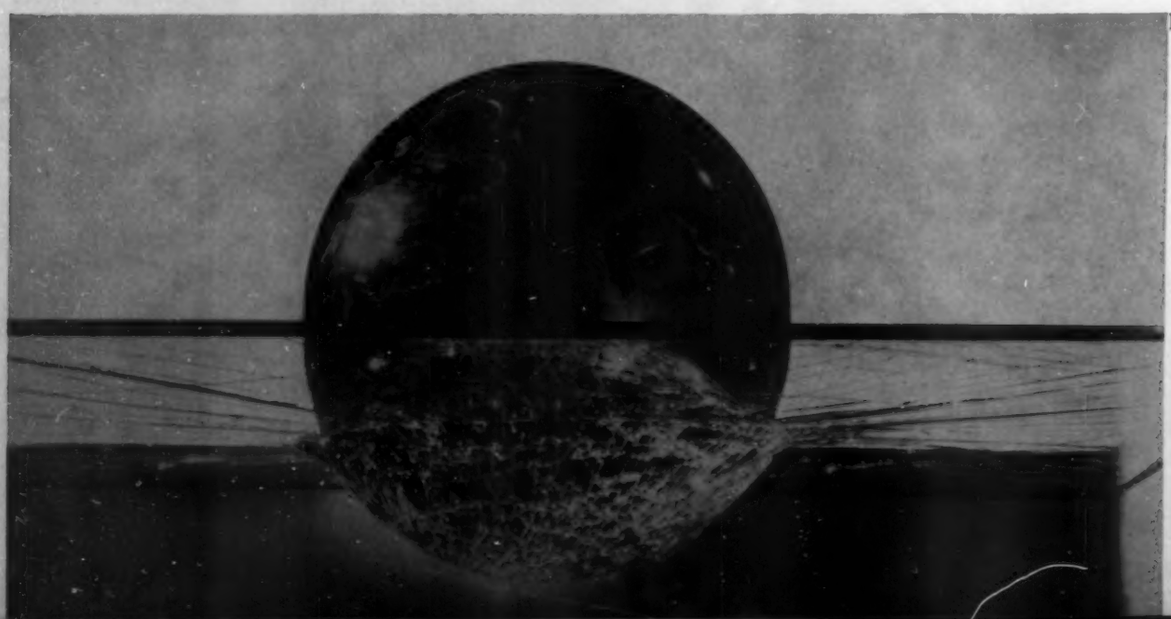
During the period in which cellulose acetate interlayer was coming into general use, there were gradually taking form some new conceptions of the role of the interlayer in safety glass, and of the combination of mechanical properties which an interlayer sheeting should possess. Previously, the protective value of a safety-glass pane had been judged on the basis of its behavior when broken at room temperature. It was considered satisfactory if the splinters of broken glass remained adhering to the interlayer, and if the interlayer itself did not break into pieces. This measure of protective behavior, and a reasonable permanence of it during the life of a car, was all that had been expected of the interlayers thus far used. But it was becoming increasingly evident that laminated glass of this quality was not good enough to afford full protection at temperatures of winter driving, because the interlayer tended to become somewhat brittle at low temperatures. Accordingly, efforts were made to develop interlayers which would give better protection at low temperatures, and some improvement in this direction was found possible, with cellulose acetate interlayers, and even with pyroxylin, by suitable selection and proportioning of plasticizer.

Another new conception, which gained attention somewhat later, was that of making the composite pane as a whole somewhat more yielding when broken, so as to reduce the bruising effect of impact of a passenger against a pane in an accident. This idea of the desirability of a so-called "rubber-bag break" was perhaps prompted by the appearance in Europe, about 1930, of a composite pane having a resin interlayer of soft, non-rigid character.[2,3]

The resinous interlayer of this composite glass is understood to have been a polymer or copolymer of acrylic acid esters. This safety glass offered definite advantages of extremely good appearance, of excellent adhesion of the interlayer to the glass, and of almost entire freedom from deterioration by exposure or aging, but it could apparently not be made to give satisfactory performance at all temperatures of service. If the interlayer were so formulated as to maintain satisfactory toughness at winter temperatures, it would be weak and soft at summer temperature; if formulated to give satisfactory performance at high temperatures, it would be brittle in winter. For this reason, and also because of certain manufacturing difficulties,[8] interlayer of this type has never come into any wide use in the United States.

The rigidity of a sheet of safety glass, and its consequent bruising effect upon a passenger in the event of impact, is due, of course, to the rigidity of the glass itself. When laminated safety glass was first made, the glass used was the same that had been used for windshields, namely, a plate glass about 0.25 in. in thickness. The resulting safety glass, comprising two such panes, was half an inch thick, and correspondingly rigid, massive and heavy. Subsequently, before safety glass came into general use, a technique was developed for the production of plate glass by a continuous process in thickness of about 0.125 in., and the laminated glass made from this had (*Please turn to page 98*)

13—In order to demonstrate the properties of laminated safety glass, this 16 lb. bowling ball was dropped on a pane of vinyl resin safety glass. It can be seen that the ball practically buried itself in the glass, but the "stretchability" of the plastic interlayer kept it from hurling through and prevented broken particles of glass from flying



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Beauty of design and precision of mechanism make this plastic register a joy to own and operate. Cash drawer springs out revealing rounded wells for change and bills, shaped to fit the fingers, and sturdy enough to withstand constant opening and shutting. An acetate window provides clear view of tabulated records

Quality rings up sales

Product styling and careful engineering create a molded plastic cash register of beauty and serviceability

FOR a machine that has money poured into it daily, the McCaskey cash register took a considerable amount out of the till to improve its appearance with plastics. Each year has seen some type of thoughtful change in the machine. This year the company turned to plastics, not to reduce costs, but simply to improve the appearance of the product so that it might take its place beside the best "high-style" and mechanically perfect business machines of today. As a matter of fact, the company was well aware that a one-piece molded housing plus changes which would be required in the metal chassis to make the entire operating mechanism a self-contained unit, independent of the housing, would result in higher manufacturing costs. The designer and the engineering staff worked together in replacing the lacquered and metal construction, and in solving the many problems.

Careful engineering was necessary to properly control shrinkage in cooling so that there would be no interference in the operation of the computing mechanism when inserted in the housing. It was thought advisable to use a metal key plate mounted rigidly on the chassis and not attached to the housing because the keys are designed to operate at a very light pressure. Even the slightest warpage of key plates would cause the keys to stay down after being pressed.

Furthermore the keys had to be set so close together because the clearance between them left no room for large tolerances. In order to mount the metal key plate in position on the chassis it was necessary to have a large opening in the housing. In addition, there had to be another large opening in the back for accessibility in changing ribbons and renewing recording rolls. An opening was also required at the front of the housing to accommodate that important part of the register, the cash drawer.

The excellence of this molding drawer is evident in the wall thickness of the wells for change and bills. They are about $1/4$ of an in. thick, smooth, sturdy and rounded to the shape of the fingers to facilitate handling of money. The five change wells are 3 in. long and 3 in. wide. Bill compartments measure 6 in. long by $3\frac{1}{2}$ in. wide. Overall size of the drawer is $10\frac{1}{2}$ in. long by 10 in. wide. When closed, the drawer fits flush against the face of the machine. Sides of the drawer are reinforced with metal strips.

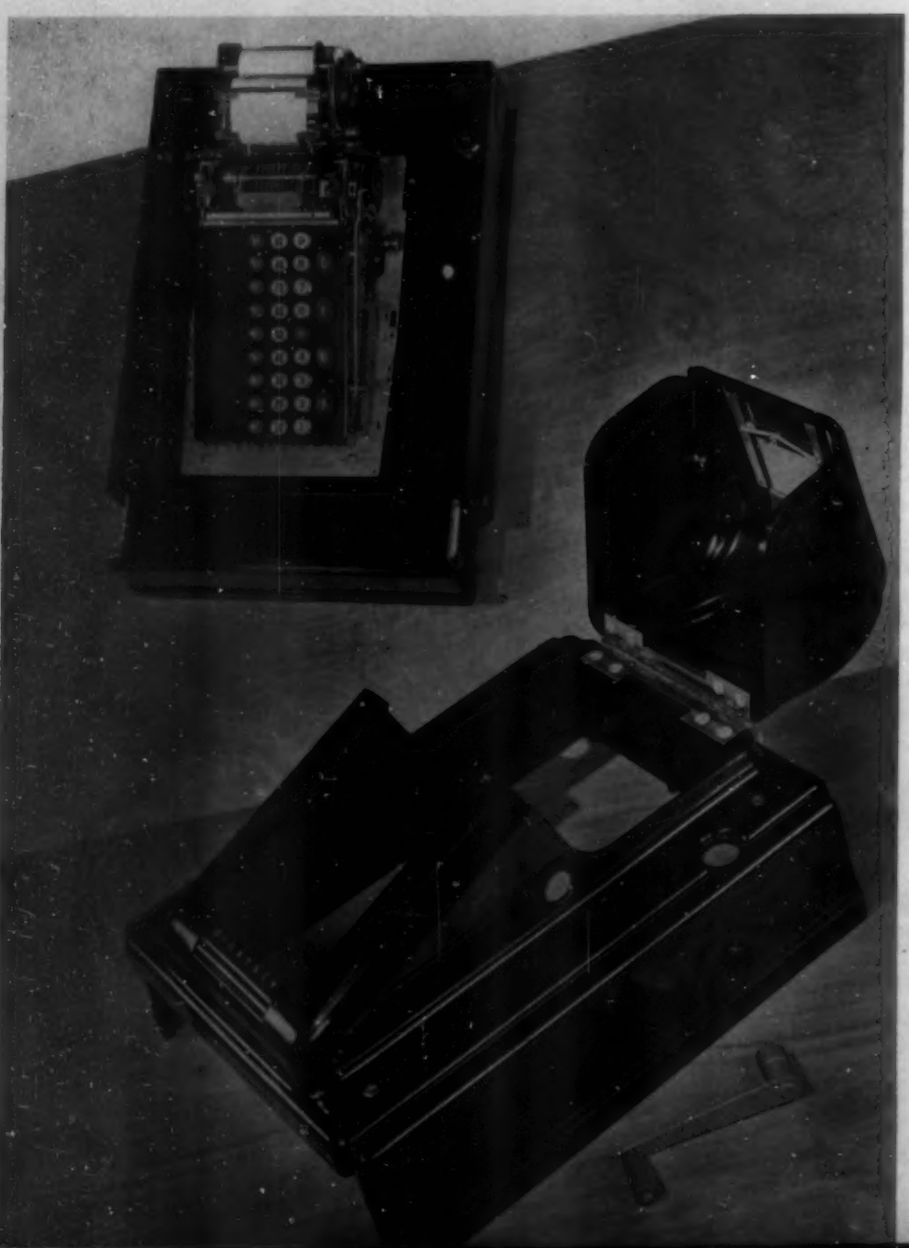
Cover over the detail strip roll on which figures are recorded has a clear cellulose acetate window. The molded plastic top comes off to facilitate changing the rolls. Decorative ribbing on the sides of this accurately molded part follows the contour of the machine.

Considerable research was done on the size and spacing of keys for the register. It was decided that the spacing, which had formerly been used and developed over a period of time, could not be improved. Appearance, according to the designer, might possibly have been improved by the use of rectangular keys, but after experimentation it was decided that the round molded thermoplastic buttons were easier for the operator to press because there was less tendency to press two keys at once.

Reinforcing ribs were molded in the housing to give maximum strength and guard against blows, or accident in shipping. Protection against shipping damage was a definite problem that had to be worked out in the development of a plastic housing for such a heavy but, nevertheless, sensitive mechanism. The problem was solved by working out the chassis in four places in the form of four recessed head screws that appear on the same horizontal surface as the key holes. This permitted the plastic housing to float, as it were, on the chassis. In shipping, the jar was taken by the metal chassis which was anchored securely to the wooden frame of the shipment.

A major advantage in the construction of the machine was that the designers were able to avoid assembling several pieces. This was important, not so much from the standpoint of cost, but because of the elimination of sharp inside corners. The result is a finished article which is extremely easy to keep clean and is an outstanding example of good appearance for this type of large business equipment. The cash register measures 15 in. long by 12 in. wide and $9\frac{1}{2}$ in. high. Dimensions of the keyboard are $6\frac{1}{2}$ in. wide by 4 in. long. Though the entire register occupies comparatively little counter space, it will—in connection with a record book—make complete records of all sales.

Credits: Bakelite Molded Phenolic. Designer, John Gordon Rideout; Molder, Northern IndustrialC hemical Co. for the McCaskey Register Company.



Here is the one-piece molded phenolic housing which fits over the metal chassis. Reinforced ribs were molded in the housing to give maximum strength and guard against blows, or accidents in shipping. One can see how carefully openings in the housing were planned to change computation roll in back. Because of the nature of the material, the register is easy to keep clean and shiny. It is also tough, durable and able to take continued rough wear and tear

Adding more than mere good looks, a removable molded cellulose acetate dust pan which doubles as a guard for the broom corn, is proving a real sales attraction. The molded plastic part will give longer and better service than metal without losing color or newness and is convenient to use

Pan-handled broom

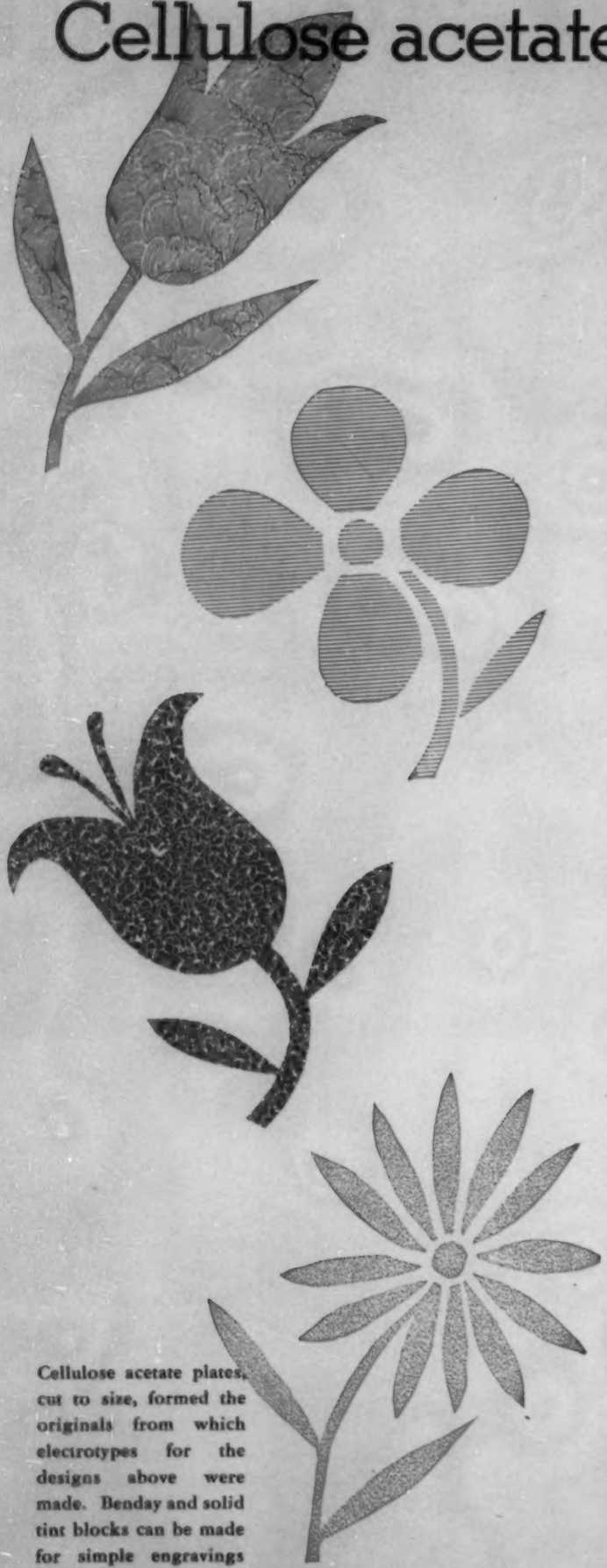
So much glamourous utility has been applied to household equipment that housekeeping has almost become a pleasure. There's sweeping, for instance. Strong arm methods still prevail for actual wielding of the broom but now an attractive plastic dust pan which fits on the broom handle, makes this job less of a chore.

Right on hand when needed, Pan-o-broom eliminates the familiar search for an elusive separate dust pan and saves time and temper. Easy to remove—just by pulling down with left thumb and index finger—it can be slipped back into place in a jiffy for future use or storage. Lightweight and well balanced, it will not interfere with sweeping and the smooth, rounded surface will not scratch furniture or walls with which it may come in contact. The bright all-through colors—red, green, or blue—which match or contrast with the colored broom corn, are a gay note, and the plastic will not chip, stain, fade or pick up odors. Washable, it retains its fresh, sanitary appearance indefinitely.

Economically injection molded of cellulose acetate, the dust pan comes out of mold finished—no further buffing or polishing is necessary. Ingenious mold construction precluded any avoidable manufacturing difficulties during the actual run.

Credits: Tenite, molded by Elmer E. Mills Corp. for Charleston Broom Mfg. Company.

Cellulose acetate printing plates



Cellulose acetate plates, cut to size, formed the originals from which electrotypes for the designs above were made. Benday and solid tint blocks can be made for simple engravings

THE year 1940 marked the 500th anniversary of the invention of printing by Johann Gutenberg. From his crude, but history-making methods, we have progressed to seas of presses, roaring and noisy that turn out thousands of newspapers in an hour, to intricate presses that print in natural colors, and to the use of plastics as printing plates. Used in exactly the same way as metal plates, these cellulose acetate plates are made up in Benday effects and solid tint blocks.

Development of these plastic plates began about 2 years ago, and at the present time, it is estimated that there are at least 7500 printers using these plates in the eastern part of the country. From brass plates upon which the designs have been etched, the plastic units are made by pressing in an ordinary, heavy duty, hydraulic press. No heat is required for this pressing operation. The plastic plates can be cut to size on any printer's saw, and it is said that the plates are good for at least 100,000 impressions.

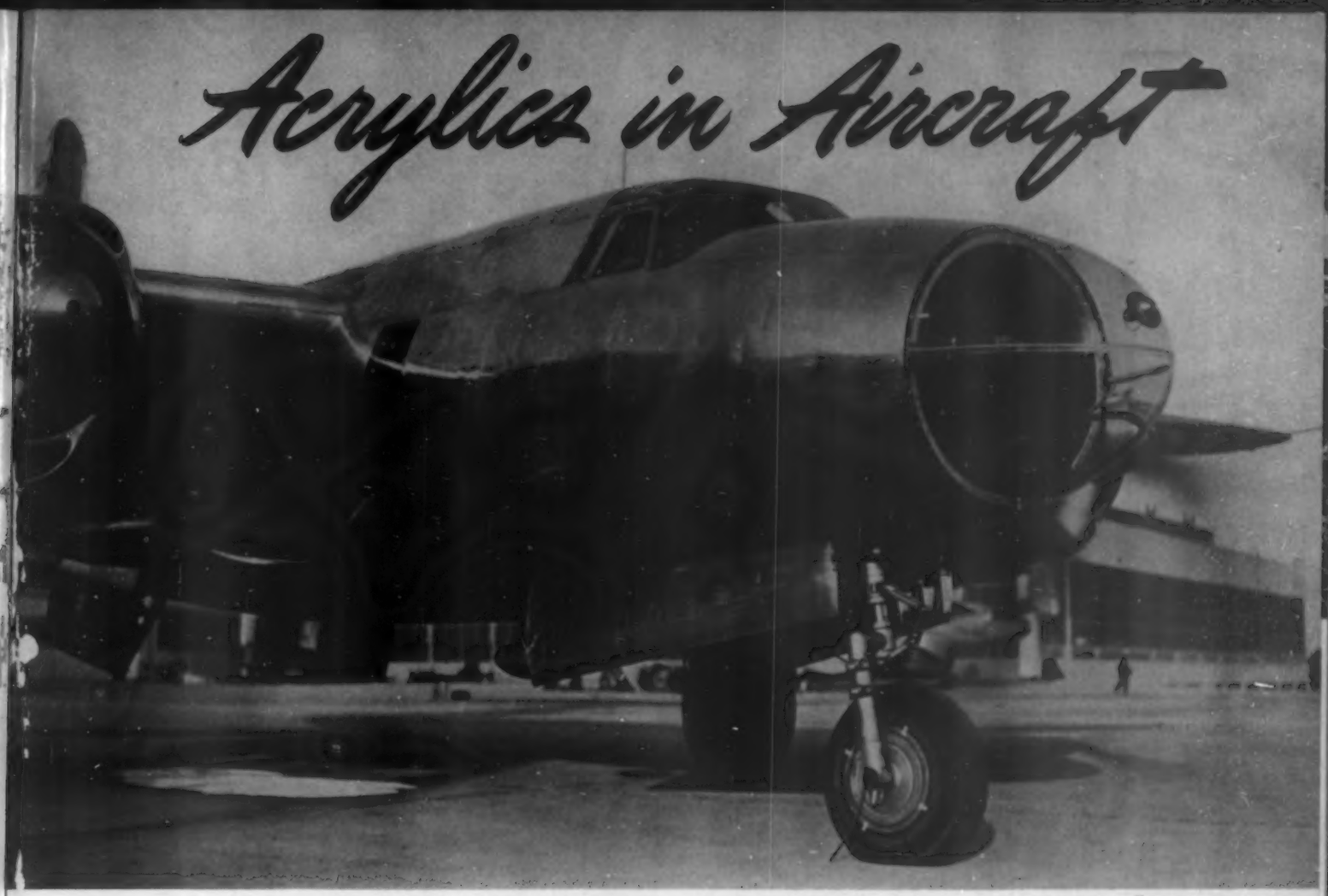
The plastic plates are mounted on wood blocks with a special adhesive. This completely eliminates the use of tacks, and consequently the necessity of shoulders. Each plate is blocked flush. It is claimed that these plates use less ink than the metal ones, and result in a considerable saving in color printing. The plates are ideal for making simple engravings, since the plastic is easy to rout, cut and tool. Interestingly shaped tint blocks to fit a special job can be cut out in a matter of minutes. The plates are type high and can be usually run along with metal plates.

One outstanding advantage in using these plastic plates in color printing is the fact that they are completely neutral in color—they are white—and will not discolor the ink. Occasionally when metal plates are used there is trouble with ink discoloration. The plates will print on any type of paper, but, of course, better impressions are possible on glossy or coated stock. This is true of all plates, both plastic and metal.

The use of plastics in the printing industry is not new, however. Cellulose nitrate was used many years ago for type faces. Some of these that are 40 years old are still good and could be used were it not for the fact that the style of the type is outmoded. In the '90's it was customary for advertising agencies to prepare a complete advertisement and have it pressed into sheets of this plastic. They would, then, mail these mats to publications in much the same manner as houses mail out papier maché newspaper mats today. It will be interesting to watch the development of plastics in this fast-moving field of printing and publishing. Those who are experimenting now, augur much of interest for the future.

Credits: Celluloid acetate by Celluloid Corp. Plasticplate by American Wood Type Mfg. Company.

Acrylics in Aircraft



PHOTOS, COURTESY RÖHM & HAAS CO.

Manufacture of transparent acrylic parts for modern bombers is put on a production line basis as America's air defense program gathers speed. This Martin B-26 bomber embodies the latest features demanded in modern combat and is reported one of the fastest pursuit planes made even when carrying its full complement of 2½ tons of bombs. Through strong, lighter than glass, transparent plastic enclosures over gun turrets, observation domes, tail empennage, four fuselage windows as well as the nose sections, the five-man crew has a clear vision on all sides

PROVIDING all round visibility and protection against powerful air blasts, transparent plastic enclosures are being formed on a mass production scale into perfectly streamlined parts. Strong enough to support machine gun mounts and withstand the terrific air pressure of 400-mile-per hour dives, clear plastic sheet and less fragile, less than half the weight of glass, is now in general use on American bombers for nose sections, "blisters" gun turrets, observation and navigation hatches, cockpit and tail enclosures.

With bomber speed quadrupled, altitudes increased, the goggles and open cockpits of World War I are inadequate protection for plane crews. At high altitudes, the bombardier has to be protected against cold and wind battering to insure perfect physical comfort vital to accurate operation of machine guns. Perfect vision to defend against attack from any angle and flawless vision are as important for the gunner as well as the pilot lest enemy planes sneak in unobserved, or blind spots distort the aim. Moreover, higher speed requires power operated enclosures so gunners can sight heavy caliber machine guns in the face of the 350-lb. air blasts flowing past the fuselage. Open cockpits would produce entirely too much "drag."

Forming these plastics sections to fit streamlined warplane contours is done by skilled workmen who use every precaution to prevent the slightest defect which might distort the vision of the crew members. Flat cast sheets protected against the introduction of dirt or foreign matter are the basis of these parts. The cast sheet as a rule is first heated until it reaches the best forming temperature of 220 deg. to 250 deg. F. Large sheets are usually hung vertically in a hot air oven, and smaller pieces heated by immersion in hot oil or glycerin. Since the material is thermoplastic, it softens sufficiently at this temperature for ease in forming and yet is not too difficult to be easily handled by workmen wearing ordinary cotton gloves.

At more elevated temperatures, the plastic sheet becomes so soft that it may develop surface imperfec-

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Skilled workmen prepare transparent acrylic parts for aircraft on a mass production basis. **1**—A hot sheet of the plastic is draped over a cloth-covered form. **2**—Edges are then quickly clamped to the form before the material cools. Heating the acrylic to 220 deg. F. makes it extremely pliable so that it can be formed to almost any desired shape. Yet at this temperature workmen wearing ordinary gloves can handle it. **3**—When the material cools it retains the shape of the form. By having several forms available, the same crew can clamp a new sheet in position while the last sheet cools. **4**—The formed sheet is trimmed to exact specifications of the plane manufactured with standard tools. **5**—Formed halves of the bomber nose are cemented together with acrylic resin. Here a worker is trimming edges of a bombardier's door and gun-mount hole so necessary hardware can be bolted in position. **6**—Polishing and buffing with cloths and power buffs are final steps in the production of bomber noses before finished pieces are bolted into place on the plane. **7**—Rear gunner enclosures are similarly made of this material. These domes can be revolved mechanically to permit swing of multiple machine guns in any direction. **8**—Transparent enclosures even under the very tails of military planes are installed. Here a workman is scribing a sheet with a sharp tool so that it can be sawed to exact size of the master template before being assembled in lightweight aluminum mountings. Great care is used throughout since any specks or distortion would affect the aim and sight of the fighting crew. The complete installation is shown on the plane on the preceding page

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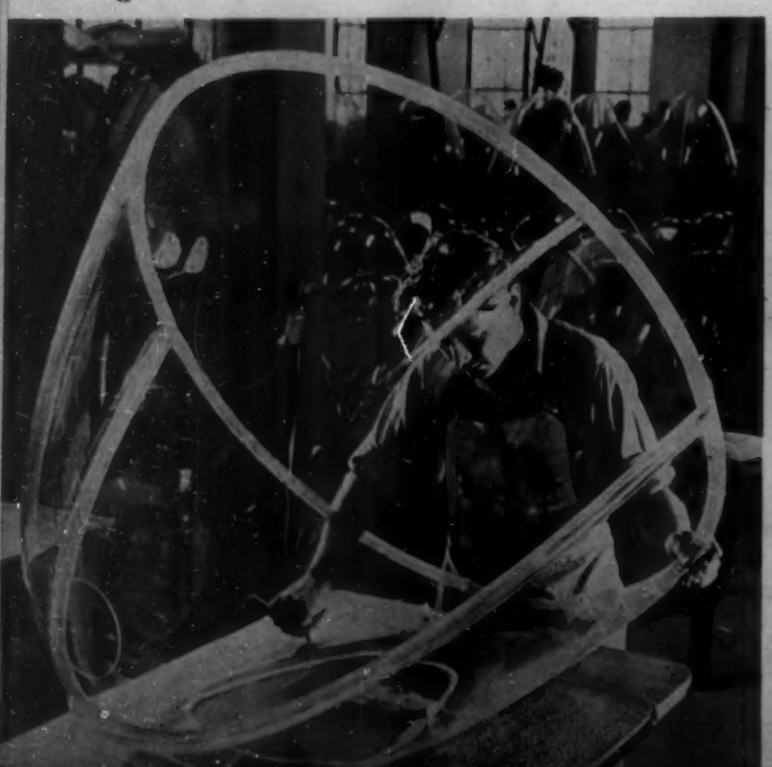

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tions, flaws or wrinkles and tends to reproduce every tiny detail of the form. Care must be taken, however, that the material is hot enough to permit it to conform to the contours of the mold without great force which might set up strains and thereby affect the strength of the part. Workmen must work speedily so that the sheet remains freely pliable throughout the operation.

The forms used may be of wood, plaster, metal or a combination of all three. The surface should be carefully sanded and covered with billiard felt or outing flannel to prevent rough surfaces. Complicated techniques have been developed for the forming of complex three-dimensional curves to accurately conform to templates (Fig. 8) or manufacturer's drawings but generally the material is stretched across the form to produce a three-dimensional curve as shown in Figs. 1–2. In addition, some sections may be pressed between male and female molds, to form the desired shape.

After the formed sheet is cool (Fig. 3), it is removed from the mold and trimmed to exact size required. Conventional tools can be used for drilling, sawing and threading and reinforcing strips can be cemented, holes may be prepared for mounting the piece (Fig. 5), edges may be routed or other adjustments made (Fig. 4). Fine-tooth saws are usually used since they leave the piece with a relatively smooth edge. For cutting thin sheets, a saw which does not have much "set" is recommended. When it is advisable to polish exposed edges, fine polishing pastes and soft linen buffing wheels should be used. Drills should be ground parallel to the axis of the drill at the cutting edge to eliminate lead. In drilling, it is also (*Please turn to page 86*)

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Fashion Frontiers

THERE are no longer any frontiers to the fashion world as far as plastics are concerned. These glamorous and practical materials have long since passed the borderlines, and are now an integral part of the world of style. Some new notes for spring and summer are found in this collection. 1—Josef of Gold Seal Importers turns to Plastacele for a new bag that will take the wind out of patent leather's sails! Plastoweave, they call the material when fabricated into handbags. It's glossy and flexible. Razor-thin strips woven into a basket weave design are used for large, handleless bags. A damp cloth keeps it bright and shiny. The bags are designed in two top zipper styles and two envelope styles. They are available in white, black, red and blue; also white with blue and white with red. Distributed by Lederer de Paris. 2—Another Josef creation is the Plasti-twine bag made of Cotacord mesh over cotton shantung. The Plastacele-coated wire bracelets are sturdy but lightweight. 3—Designed by Sol Berger of Metal Knit Co. for Gold Seal Importers, this rope-like necklace, belt, bracelet and handbag trim make a smart accessory ensemble. Clear Plastacele coated wire is also used here. 4—You can dress in Vinylite from head to toe, if you've a mind to. The crown and brim edge of this black braid picture hat are made of crocheted strands of the extruded transparent plastic. Collar, glove cuffs, belt and pockets are made of the same material in very thin strands. If your taste does not run along such lavish lines, use the plastic sparingly, and

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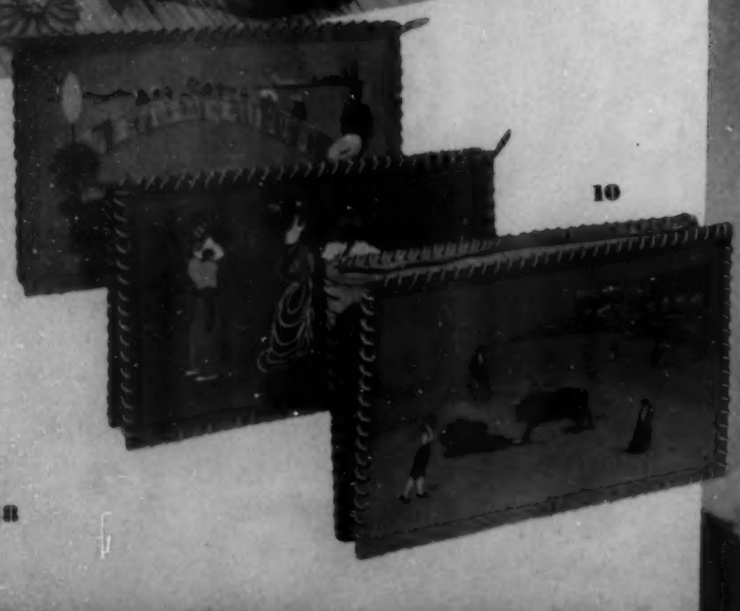

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you'll have an even smarter effect on your basic black dress. 5—Why, of course, here comes the bride—it's June now and high time for that sort of thing. This modern bride wears a bridal gown of medieval design touched up with a headdress combining mantilla and cape, and intriguing mitts all made of glistening Vinylite. The crocheted plastic mesh is something new and very smart. This gown was shown at the Fashion Futures show. 6—Exotic, ragged-edged flowers of this same vinyl sheeting adorn the bodice of this white chiffon evening gown designed by Frank Brady of Lord and Taylor. Scissor-cut from sheets of the silvery plastic, the material is ideal for flower trimming and hair ornaments. 7—The turban! Always smart and chick for those who can "get away" with it, the turban is one of those styles that is ever good—particularly when well draped. If you've never had one made of Vinylite, try it sometime. They are handsome and extremely serviceable. This one is in rose, blue and pearly white. Since the material is waterproof, resistant to tearing and easily cleaned with a damp cloth, it should be on the "must" list of the well-dressed woman. Louisesanders styled and made this one. 8—Another version of the smart, well-tailored handbag uses spring-like coils and straight strips of Tenite for decorative trim. Not only attractive, the plastic, applied as it is to the edges, helps to prevent wearing and soiling. The bags are designed by Martial & Scull for Propper Handbag Corp. 9—Refreshingly crisp and lifelike with the dark green of their leaves, blood-speckled tiger lilies, crimped petaled carnations, purple fronded Shasta daisies blossom forth in Lumarith to help make your new spring costume more beautiful. They are made from sheet material for Bailey, Green & Elger Co. 10—Delicate work in enamels on transparent Lumarith which is laced over beautiful, textural fabrics strikes a new note in handbag designs. Each bag is really a conversation piece because of the exquisite workmanship. For example, on one depicting a cock fight in Mexico, each feather of the birds seems ruffled. The subjects are international, but most of them range

through Central and South America in good-neighborly fashion. Others are from Old France and from the Far East. The original paints are by Lorraine Leland; bags by de Calsta Originals. There are gloves to match with the same plastic trim. 11—Are you keeping up on current events? Then let the world know you are well-informed by wearing a novel, up-to-the-minute charm molded of Fibestos by Inlaid Optical Co. 12–13—Colorful animals and birds, or military emblems are yours for decorative pins on summer frocks in this latest output of Catalin jewelry. They brighten any dress and are inexpensive enough to tempt sales. Fabricated by Ortho Plastics Novelty Co., Inc. 14–15. The summer hand bag problem is neatly solved with cool-looking Lumarith bags that won't smudge or take finger marks. Bag with handle has polka dot trim. Basket weave bag can be swung from wrist. Manufactured by Schoenfeld and Wolf, Inc. and Nat Greenbaum, respectively. 16—Another washable bag in multi-colored effects is made of Tenite, woven from extruded strips by William Wilder Co., Inc., from material supplied by American Rattan and Reed Co. Bracelet also of Tenite coiled in a springy band by Plasticoid Distributors. Both materials extruded by Detroit Macoid Co. 17—Blossom buttoniers for Milady and Defense pins (18) are of Parkwood. They are laminated with Textolite and woven wood veneers. The finish brings out the grain of imported woods from Africa, Middle West and New England. There are also cigaret cases and compacts to match which have the same smart appearance as the other accessories, to round out a complete fashion ensemble.

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Salt and pepper servers

"Swanky," a new salt and pepper server with a finger tip control, has been molded of polystyrene in a variety of bright, clear colors including red, green, blue, yellow and black with a white button for salt and a black one for pepper. The push button mechanism operated from the top releases measured amounts of salt from the bottom of the container. This "metering valve" gives trigger touch, quick action control, provides for even distribution of salt and pepper without sticking or clogging. The chief problem in manufacture was selection of a colorful, lightweight material that would be sanitary, durable and attractive and, moreover, unaffected by atmospheric conditions—a major cause of jamming in salt dispensers. All parts are injection molded. The body of the server is produced in a single cavity mold about $2^1/_2$ in. to $1^5/_8$ in. diameter. The material for the inside thread part is injected through a ring gate and the cap is molded in a four cavity mold. Plungers are also molded on a split cavity mold of four cavities. Two gates are used to inject the material on opposite sides of this part. The plunger is $4^5/_{16}$ in. high and $5^1/_{16}$ in. in diameter at the base. The base measures $2^1/_{16}$ in. wide. Domestic quarrels are practically outcast at the table which boasts these salt and pepper sets.

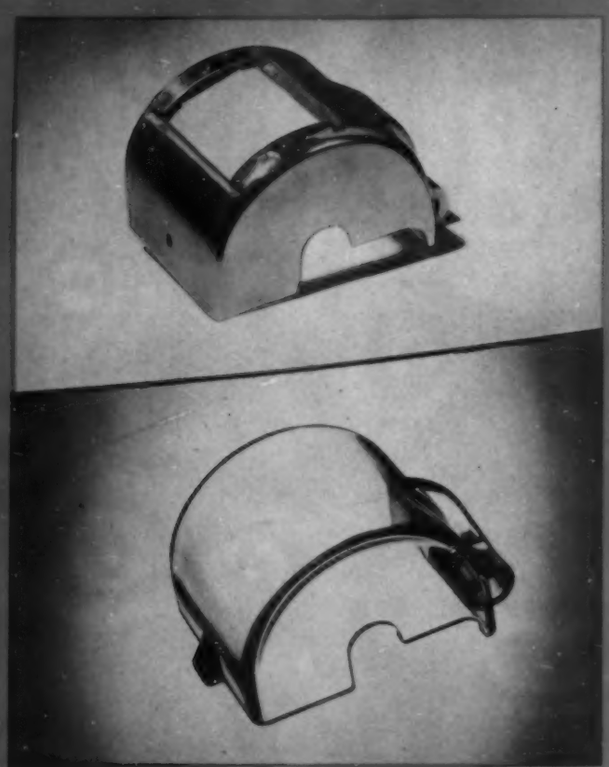
Credits: Bakelite polystyrene molded by Chicago Molded Products Corp. for the Oster-Bauer Shop.

Product Development

Transparent guard

Improved all-around visibility, greater durability and economy of manufacture, added to the fact that plastics have been used to replace a metal conscripted for vital defense purposes, bring this new safety guard into the front line. Injection molded of clear methyl methacrylate resin, the device (shown at lower right) replaced a machinery guard formerly made of aluminum with a tiny glass window inset (pictured at upper right). Installed as a protection against the whirling machinery on a coil winding machine used in the manufacture of electric light lamps, the completely transparent plastic guard enables the operator to watch the entire process whenever inspection is required. Formerly, he could see only a small part of the operation through the glass aperture. The one-piece construction of the plastic unit eliminates the assembly problems involved in the metal frame and glass window of its predecessor. It can be installed in a jiffy, and is easily removed for cleaning or when mechanical repair work is necessary. Strong and practically unbreakable, the methyl methacrylate guard weighs approximately $1^1/_2$ lbs.—just about half as much as the combination it replaced. It measures about 3 in. wide by 2 in. high and was economically produced in large quantities.

Credits: Crystalite, molded by Plastics Dept., General Electric Co., for G-E's Nela Park lamp factory.

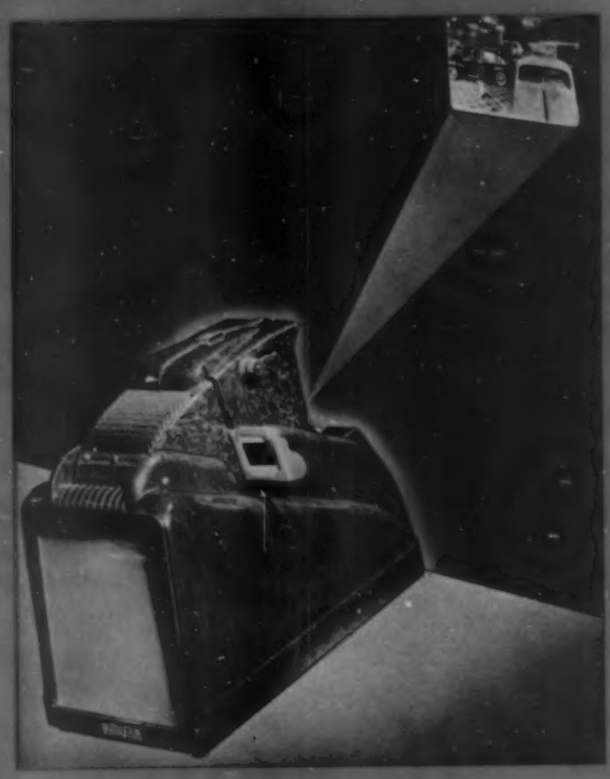


Water bottle heater

Keeping the hot water bottle really hot for any length of time has long been a problem that has stumped even the experts. It seems that there are few things worse than waking up in the middle of a cold wintry night to find what seems like a cake of ice in the bed—but it is only the hot water bottle turned stone cold. Now a new molded plastic electrical device has come to the rescue. Claimed to be able to keep the hot water bottles at any one of four degrees of temperature, this unit has been made practical through the use of molded phenolic plastic. It is said that this is the only material tested which will stand up under the electric current in water without arcing. Molded in several parts with several connectors integral in the plastic, the thermostatic control functions efficiently. A glance at the device will show that it is simple to use, and the fact that this particular type of plastic is ideal for all sorts of insulating purposes gives even the most squeamish a feeling of safety and security. Use of the unit in the sick room is ideal. The hot water bottle does not need frequent refilling, a procedure that is very disturbing to the patient. Use of the Tepco unit prevents frequent change of wet dressings due to dry heat, fire hazards, uneven temperature and electric shocks. The plastic is sturdy, and almost unbreakable.

Credits: Durez molded by Southwest Machine and Plastic Co. for Thermo Electric Products Co., Limited.

Product Development



Projector viewer

By a simple tilt of the top section of the unit, the Novex combination projector may be changed to a film with an image viewer, 7 in. by 7 in. on ground glass in broad daylight. Rugged and permanent in color, the projector viewer is constructed with an actual draft ventilation. Production and assembly costs were kept at a minimum, since the lightweight phenolic housing was molded to final dimensions in 7 sections, one of which comprises the entire 14-in.-long body. These accurately fitting parts can be assembled rapidly with the glass and metal units because bosses, channels, lugs, screw-holes and similar constructional details are all formed in the molding process. The pieces emerge from the molds with a lustrous finish that cannot wear off. No subsequent machining or finishing operations are necessary, which means an additional reduction on the overall cost. The heat-insulating and heat-resisting characteristics of the material assure continuous operation without damage to the film or discomfort to the operator. Originally made in metal the plastic device permits detailed enlargements of numerous negative sizes, and yet the plastic housing weighs less than 5 pounds. It can be used to show dental X-rays, glass slides or Kodachrome ready mounts.

Credits: Bakelite phenolic molded by Molded Products Co. for Novex Corp. Designer, Worthy Chambers.

ARP Apparel

AIR raid costumes for men, women and children—grim fashion note, indeed—combine a maximum of safety with a minimum of ugliness. Incredibly lightweight in proportion to their strength, laminated plastic plates shaped to fit the body, form the real "armor" inside these garments.

The clothes for women even allow for a bit of feminine appeal with a hood draped gracefully over the helmet! Men's costumes combine safety with good tailoring and baby can sleep with a degree of safety in the chemically treated baby bag.

Costumes were designed by the wife of a New York physician in cooperation with a well known designer, who looked to the field of plastics for the perfect protector. Experimentation on the part of chemist and the work of the manufacturer, over a twelve month period, have turned out fireproof costumes into which are slipped formed plastic plates to guard the vital portions of the body. There is also a helmet and a flashlight as part of the costume.

The dress and poncho are made in a fiber material resembling khaki, in light green, brown and dark blue.

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1—Attractive suits of fireproofed fiber-type fabric form the basis of air raid protection costumes. Resilient, thin plates of laminated plastic shaped to the body are slipped into pockets to prevent serious injury from flying shrapnel and bomb fragments. A special lightweight rigid helmet is part of the outfit. 3—Infants can be wrapped in a sleeping bag similarly equipped

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2—A blackout safety signal light snaps on and off with finger tip pressure. Injection molded of methyl methacrylate it transmits light in all directions. An acetate cap which fits over one end forms a stand or cover

These are rendered fireproof by a special process. Of sufficient thickness and impact strength to resist shrapnel and splinters, as evidenced by rigid tests made by the manufacturer, thin plates of laminated plastic, resilient and unbreakable, are slipped into the costume. There are two at the shoulders, one at the back and two breast plates, also one for the abdomen if required. Any sharp object striking the costume will become embedded in the plastic material which tends to block, or retard, complete penetration. Thus the plastic tends to break the force of impact, reducing the possibilities of serious injury. Costumes are not bullet-proof, but since most injuries are a result of flying shrapnel and other objects dislodged by bombing attacks, these clothes are considered important in promoting civilian safety.

One air raid costume resembles a ski suit. It has a blouse with hanging pockets in back and front. The plates are slipped into these. They are approximately 1/4 in. thick and shaped to the body.

It is the pliability and strength of the plastic that makes it an excellent material for protection. Plates are claimed to be stronger than cast iron although their weight is from 3 to 8 lbs., according to number of plates worn. Compare this to a suit of metal armor which totals 50 to 75 lbs! A pointed hood hangs from the shoulders. This has slits for vision and can be pulled over the hat to protect the face and eyes. Slacks are worn instead of a skirt.

The poncho is made of the same material, with plastic plates inserted in folds, back and front. A flat headpiece with eye slits protects the face and eyes when the poncho is worn over a (*Please turn to page 86*)

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4—A poncho of the same material with plastic plates inserted can be worn over a dress or used as a blanket **5**—Close-up shows inside of outfit and the pointed hood to protect face. **6**—For men, a suit complete with hood, is designed for comfort and action

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PLASTICS IN REVIEW

1 Perhaps the neatest trick of the week is the Parker "51" pen which holds ink that "dries as it writes." A patented cylindrical comb of Lucite within the barrel traps ink overflow, permits a radically different construction and makes the pen proof against smudging and leaking. Chemically resistant casing is of the same material in black, blue or red with silver or gold cap

2 Lovely colors and fanciful motifs of Disney's "Fantasia" have been effectively used in the Humming Bird Nylon Display. Petals of the flowers are cut and formed from 125-gage clear Fibestos, cellulose acetate, sprayed with pink on the underside. Wings are of clear acetate airbrushed on underside for fog effect. Water lilies are plastic, too. Designed and fabricated by W. L. Stensgaard & Associates

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5 Busy executives will find this combination desk lamp, pen holder, ink well, with trays for pencils and clips an aid for whizzing through the day with a minimum of fatigue! It is made from walnut mottled Bakelite phenolic. Bed lamps using shade portion only are available in urea in soft pastel shades. Molded by the Atlas Appliance Corporation

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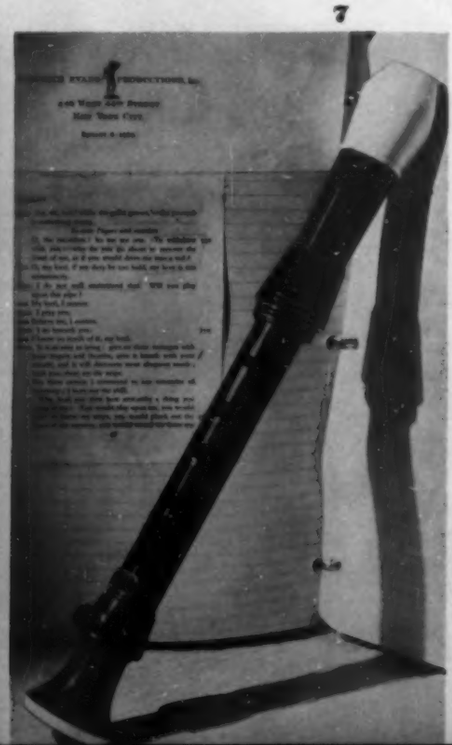

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4 Women will actually mean it when they say, "Oh, how I love to see a man smoke a pipe!" if you use these. A sweet, bland smoke is made possible without usual "breaking in" since the heat and tremendous pressure required to form the Durez bowl is said to extract impurities from corn cob liner. Manufactured and molded by Phoenix-American Pipe Works

5 Rich color and high luster characterize this Catalin chime housing recently adopted by NuTone Chimes, Inc. Color is all-through and permanent and in keeping with the soft muted tones of the bell and the modern "classic" design

6 Once again plastics releases aluminum for defense purposes. These Westinghouse refrigerator parts for controlling temperature are injection molded of Tenite II and they won't peel or chip. Low heat conductivity makes the molded parts warm to touch, a pleasing change from enameled metal. Molded by Bryant Electric Company

7 Shades of Shakespeare, the recorder of 18th Century fame lives again! It's the Dushkin Recorder, of cellulose acetate and able to play the same mellow music that so delighted Mr. S.'s Hamlet! It is molded of Lumarith and available in soprano, alto, tenor and bass

8 Molded urea holders glorify the Bab-O can into a decorative household item. Sales promoting, they are available in red, blue, green and ivory to slip over the cleanser. Rubber closure base will not scratch or leave stains. Molded of Beetle by Mack Molding Co. for B. T. Babbitt, Incorporated

9 Clean water on tap for users of "Filto-Kleen!" This gadget filters water through fiber disks. The filter is molded of Bakelite phenolic in colors and is both non-corroding and permanently finished. Disks used are easily accessible and simply replaced. Gulliksen Mfg. Co. molder, for Filter-Kleen Mfg. Co.

10 Soda-Mizer siphons soda straight from the retail bottle, but also seals and saves the contents indefinitely. Colorful polystyrene top and button are unaffected by water, fruit acids or cleansings. Molded of Lustron and assembled by Waterbury Button Co. for Howard L. Ross Corporation

11 This efficient looking Plexiglas box is a demonstration beer-dispenser unit used to show clearness of liquid going through the cellulose acetate butyrate tube inside with a 40-lb. pressure. The box is 15 in. sq., 13 in. high and $^3/_8$ of an in. thick. Designed and constructed by House of Plastics with Tenite tubing extruded by Carter Products

12 Mello-Chime and Signal Co., Inc., adapted molded phenolic for housings and backs of a portion of its 1941 line. The material is non-resonant and non-reverberating. The all plastic model requires no finishing, is self-insulating and lightweight. T. F. Butterfield, Inc., molds them of Durez

(Please turn to page 58)

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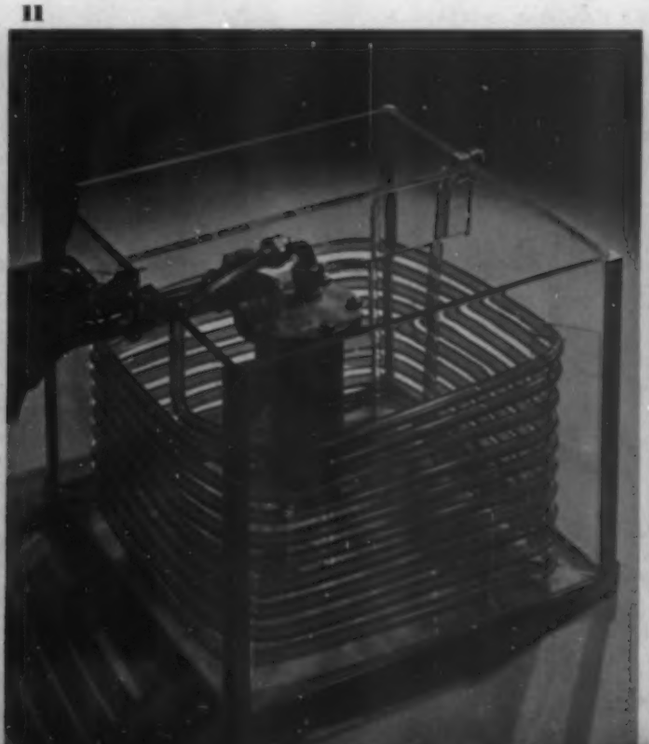

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SPI meets at Hot Springs

THE attendance at the annual spring meeting of the Society of the Plastics Industry held at the Homestead Hotel, Hot Springs, Va., May 4–6, was the largest in the Society's history. The formal business program, which was received with enthusiasm, while a departure from the scheme of previous meetings set a precedence for the future. It also indicated the serious-minded attitude of the plastics industry toward the nation's defense effort.

In addition to transacting the routine business of the Society, directors and officers were elected for the ensuing fiscal year. They are: Ronald Kinnear, Niagara Insul-Bake Specialty Co., President; E. C. Maywald, Chicago Molded Products Corp., Vice President; William T. Cruse, MODERN PLASTICS, Secretary-Treasurer; and Henry J. Kasch, Kurz-Kasch, Inc., Chairman of the Board. Directors are Donald H. Dew, Die Molding Co.; Charles J. Romieux, American Cyanamid Co., Plastics Div.; Frank H. Shaw, Shaw Insulator Co.; H. S. Spencer, Durez Plastics and Chemicals Co.; and E. A. Stillman, Watson Stillman Company.

The business program included addresses by Glen O. Smith, lawyer, of Cleveland, Ohio; Lt. Col. K. F. Adamson, Ordnance Dept., U. S. Army; James A. Lee, Managing Editor, *Chemical & Metallurgical Engineering Magazine;* N. J. Rakas, Rubber and Plastics Laboratory, Chrysler Corp.; and Dr. D. P. Morgan, Director of Division of Priorities, O. P. M.

Glen O. Smith, who for many years has been identified with labor relations problems and employers spoke on that subject. His informative address was received with keen interest. A brisk question and answer period followed his introductory statement.

Ronald Kinnear, SPI President, 1941–1942

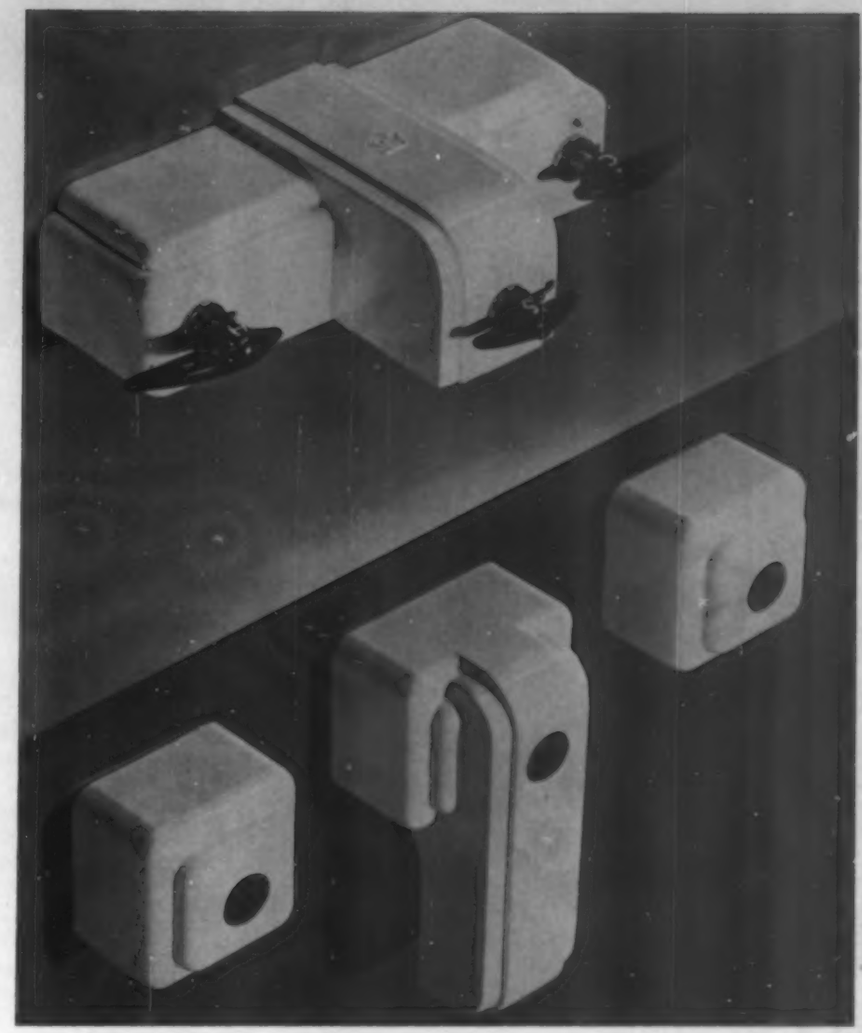
Mr. Smith stated that the employer's responsibility was the care of those working for him. The employee's duty was, in turn, to know his job and to do it. With proper supervision and clear understanding the majority of troubles could be overcome. Nothing was to be feared from honest unionism Smith stated. He emphasized honest unionism was desirable, that industry's troubles were its own fault. Industry, said Smith, had been indifferent toward personnel problems. and remiss about doing anything about them so the labor professionals had come in to handle affairs. Labor problems, he stated are 90 percent supervision. Everyone from president to waterboy must be loyal to his company. Good plans for working, just wages with firmness and fairness for all were the order of his suggestions. In conclusion, Mr. Smith declared that laws won't create the spirit of these intentions. In fact, outlawing strikes will only make matters worse.

Highlights of the other papers which were delivered at the meeting are presented here. The following talk by Lt. Col. F. Adamson, Ordnance Dept. U. S. Army, on the subject "What the Ordnance Department Expects of Plastics" discusses in full the demands of what that department wants and expects. He described in detail several comparatively simple items showing why they should be made in plastics and tests to which they should be subjected. A number of these experimental molded plastic parts which are being developed are shown on page 88. His talk follows:

"There are many places in the procurement program where plastics can and, of course, will be used when those uses duplicate or parallel commercial uses in force today. There are possibly military uses which so nearly parallel the standard products that the slight modifications, which would be a distinct advantage to all concerned, would result in their adaptation. These commercial, or correlated commercial, adaptations and substitutions will be disregarded by me and I will immediately enter into the discussion of individual items with which we have had experience and in which we hope plastics can be used.

"The first item which we thought would lend itself readily to the use of plastics was one spoken of as the *fuze well cup*. This cup is screwed into the nose of the shell after it is loaded with TNT and, in a way, prevents the breaking of the TNT due to rough handling. This is desirable in that when the fuze with its booster is screwed into the shell, either in the loading plant or at the gun position, assurance will be given that particles or pieces of TNT are not either caught in the threads or compressed by this operation. The item was so simple in construction and since, as we then saw it, it was required to undergo no real strain, that after a preliminary investigation many thousands were assembled into ammunition. After one year of storage, much to our sorrow all of the ammunition had to be broken down, unpacked and the faulty fuze well cups removed.

As these cups were inserted, they were screwed down so that the bottoms rested on the smooth, flat surface of the finished TNT. TNT, of course, expands due to changes in temperature, with the result that this expansion pushed the bottoms of the cups out and broke them into numerous pieces so that an even more dangerous situation had (*Please turn to page 88*)



Gleaming white or black injection molded acetobutyrate fixtures enhance the beauty of the modern bathroom. Readily cleaned and simple to assemble, these durable sink or tub units are no problem to housewife or the plumber. Single units as the 8-in. type (at upper right) or 12-in. sets of three fixtures, (lower right) meet standard plumbing requirements

Molded plumbing hardware

WITH the dark age of the Saturday night scrubbing ritual long since past, the decoration, color scheme and equipment of the modern bathroom has become a major consideration of the architect and homemaker. Plastics have previously found a niche (literally) in wall fixtures, towel racks, shower heads, soap dishes, tumblers and even custom-designed and specially fabricated faucet handles. Now complete streamlined, ready-to-install units—hot and cold water faucets and spout—are being economically produced on a mass production basis. Injection molded of cellulose acetate butyrate in black or white, these attractive fixtures are available in different sizes and designs to conform to existing specifications.

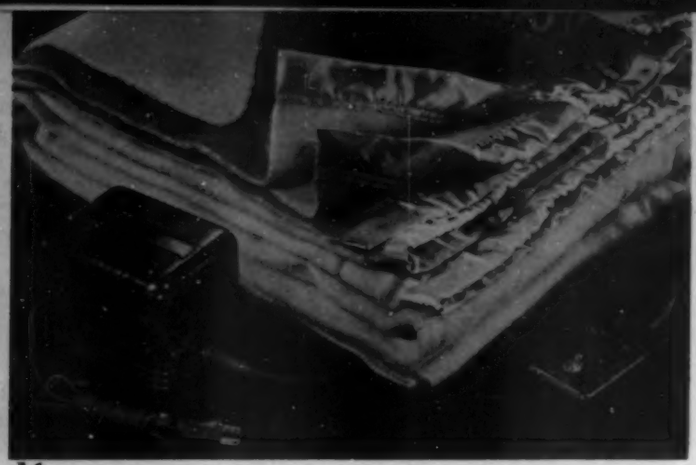
Regulation units are made for standard plumbing fixtures in sizes of 4 in., 8 in. and 12 in., determined by center-to-center measurements of the plumbing. The 8-in. and 4-in. fixtures combine hot and cold faucets and spout in one piece, each run in a single cavity mold.

The 12-in. fixture has three parts: two little boxes $2^3/_8$ in. square, fit over the hot and cold plumbing outlets, and have an opening for inserting lever handles. A longer piece forms the center portion for the spout and drain control. Molded over a metal core, levers, in contrasting colors with wiped-in lettering, are of the same material and run in 4-cavity molds.

Clumsy, cumbersome fixtures both porcelain and metal were a problem to the shipping department and to the consumer, but the plastic fixtures weigh comparatively little, yet are tough in service and practically unbreakable. Color is permanent and all through. There is no danger of yellowing, fading, chipping or peeling. The plastic fixtures will stand up under strain and will not corrode or tarnish like metal. The smooth rounded surfaces will not scratch and cleaning is simple. Soap and water do the job. No other polish is needed.

Credits: Tenite II, molded by Franklin Plastic and Die Casting, Div. Baldwin Laboratories, Inc., for Glauber Brass Mfg. Company.

13



14

PLASTICS IN REVIEW

13 A head of soft, curly hair is yours with "Magic Wand," and automatic curler which claims to release curls without crushing or breaking the hair. It is made of two fork-like pieces fitted together to form a rod on which the curl is rolled. Metal clips are attached at one end. It's molded of Bakelite polystyrene in several color combinations by Superior Plastics Company

14 General Electric claims that one third of your life is spent in sleep, so why not be cozy and warm? An automatic electric blanket incorporates 3 molded parts of Textolite, molded by G-E's Plastics Dept. Transformer is suspended under the bed and connected to the small control case with a 6-ft. cord. Especially insulated heating wires of stranded copper are secured in individual channels between double warp of the blanket

15 In order to show actual working operation of its Trident Water Meter, Neptune Meter Co. developed a Plexiglas model for exhibition and examination by water supply engineers. With the exception of gears and bearings, which are of metal, the entire meter housing and fittings are machined from blocks of this optically clear acrylic plastic. The Museum of Science and Industry fabricated the meter

16 Colorful molded Lumarith shower hooks and tie-back bring Grecian distinction to the bathroom. The smooth hooks will not tear the fabric or scratch hands. Rust-proof, sturdy, tough, they are made by Blossom Mfg. Co. in matching colors

17 For use in plants handling explosives, Formica has developed a factory truck wheel which is non-metallic and will not strike off sparks. It is also grounded by electrical conductors so that static cannot build up a potential in the truck which would result in a spark. A conductor is embedded at the hub and near the rim, and another conductor connects the two. Colloidal graphite mixed with the plastic rim and hub serves to complete the connection

18 These charming table appointments are the new "Bundles for Britain" items. The vase and cigaret case are of Lucite, and the popularly priced mat is cellulose acetate. Available at Jane Ross Studios and "Bundles for Britain" branches

19 Sectionalized cosmetics tray is molded of Durez by Niagara Insul-Bake Specialty Co., Inc., in one piece for Dermetics. It has a high luster finish and each section is accurately spaced. Name is molded in and then given a white enamel wipe-in. It is light, serviceable and easy to keep clean

20 Rich brown arm rests for theatre seats by Air-Loc Seat Industries, Inc., are molded of Durez by Raymond Laboratories. They have a smooth, lustrous finish that will last indefinitely. An added advantage is that they do not burn readily, nor will they chip or mar

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21 Here is an attractive 1-oz. jar of Roger and Gallet's Lip Pomade with a white Artmold Cap. Molded of Plaskon, or Beetle by Armstrong Cork Co. Etched on the cap is the product and company name, address, and an outline of feminine lips. Such a coverage precludes use of further labeling

22 Otherwise amiable men have been known to swear roundly at leaky pens, but with Shaeffer's Lustron Dry-Proof reservoir base desk set the day is saved! A special feature keeps ink always at the same level and only the tip of the point is immersed. Flat design and rubber feet prevent tipping and sliding. Base is molded by Chicago Molded Products Company

23 Batteries for the new "General Duro-Lite" flashlight come in a sealed tube which serves as a barrel for the assembly. This screws on to a molded husk and transparent lens cap of Tenite. These parts remain in use as batteries are replaced. Husks and lenses are molded by Peerless Molded Plastics Co. for General Batteries, Inc. Assembly by Fulton Mfg. Company

24 Universal Microphone Co., Ltd., have introduced this CU-1 model for private airplane and yacht installations. Molded black Bakelite phenolic gives necessary moisture resistance, lightness and durability. Some of the features of the device are: single button carbon, moisture proof cord $3\frac{1}{2}$ ft. long, motor-noise damped out by anti-noise construction and "push-in" mounting bracket. Molder is Ralph Barnes

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Classy Casters for

The ability of Plaskon to add sparkling touches of color to heretofore neglected parts of merchandise is illustrated in this application of the new Bassick casters. Adequate strength for these casters is assured by proper consideration of design, utilizing the inherent characteristics of Plaskon. The colorful Bassick casters are molded of Plaskon for The Bassick Company, Bridgeport, Connecticut, by the Plastics Department of the General Electric Company, Pittsfield, Massachusetts.

Charlie's Crib!

One of the newest and most novel uses of Plaskon Molded Color is in the commercial production of casters for the famous Bassick Company.
These Plaskon casters are being adapted to many types of merchandise, wherever the strength and beauty of Plaskon offer production and sales advantages.

Not only does this new use of Plaskon impart a touch of color and sparkle to a heretofore neglected part of furniture, but it also assists in the release of metals essential in the defense program.

Adequate strength can be supplied by Plaskon Molded Color for a wide range of product needs, when proper consideration is given to design and service needs. Besides meeting stress and strain requirements, correctly-molded Plaskon offers the added advantage of light weight without sacrificing durability.

Plaskon is available in a wide range of rich, beautiful tones, offering unlimited opportunities for new product creations. These tone values are unchanging, for Plaskon is solid color through and through. Plaskon will not corrode, rust or tarnish. Its smooth, hard, non-porous surface cannot be stained or scratched.

Are you searching for new opportunities to increase profits in production and sales? Plaskon offers you new manufacturing speed through efficient, low-cost molding performance . . . new sales appeal for your product through greater beauty and modern design.

We shall be glad to give you the benefit of our technical experience in adapting Plaskon Molded Color to your production and sales-promotion needs. Write for a Plaskon representative to call upon you. Plaskon Company, Inc., 2121 Sylvan Ave., Toledo, O. Canadian Agent: Canadian Industries, Limited, Montreal, P. Q.

Trade Mark Registered

PLASKON

★ MOLDED COLOR ★

Reprints of all stock mold pages which have been published to date with a complete index of suppliers are available to Stock Mold Service Subscribers

Stock molds

SHEET ONE HUNDRED-EIGHT

Utilitarian knobs for kitchenware, cabinets, radios, furniture, etc., directional and control handles, and tube caps in standard sizes are available without mold cost. For manufacturers' names and addresses, write Stock Mold Dept., Modern Plastics, Chanin Building, New York, giving item and sheet numbers

1253. Tapering control handle, 3/4 in. in diameter. 2 1/4 in. long. 1/4–20 in. stud, 3/8 in. long

1254. Tapering control handle, 3/4 in. in diameter. 2 1/4 in. long. 3/8 in. opening at base. Plain or threaded holes

1255. Replacement knob, 7/8 in. high. 3/4 in. in diameter. Complete with 1/8 in. screw

1256. Replacement knob, acorn shape, 1 in. high. 3/4 in. in diameter. Complete with 1/8-in. screw. Overall height 1 1/2 inches

1257. Replacement knob, globe shape with ridged beads around center. 1 in. in diameter. Complete with 1/8-in. screw

1258. Round control handle with ridged rim. Overall diameter 1 3/4 in. 3/4 in. high. 1/4 in. molded hole or brass insert. Also in 1 in., 1 1/4 in. and 1 1/2 in. heights

1259. Binding post and switch knob, 31/64 in. in diameter. 1/2 in. high. 6/32 and 8/32 brass inserts. Also available in 5/8 in. and 3/4 in. heights

1260. Radio knob, acorn shape, 3/4 in. high. Diameter 3/4 in. 1/4 in. opening at base and 1/8 in. diameter side screw

1261. Pointer knob, 1 5/8 in. long. Diameter 3/4 in. Height 19/32 in. Overall length including metal pointer 1 15/16 in. Metal insert

1262. Pointer knob with wiped-in arrow. 1 1/4 in. long. Diameter 3/4 in. 1/4 in. opening. Available with or without insert

1263. Round threaded tube cap, with fine knurl rim. Base 1/4 in. in diameter. 3/8 in. diameter top. 1/4 in. high

1264. Octagonal tube cap, 1/2 in. overall diameter. 1/4 in. high. 5/16 threaded opening

1265. Round tube cap, fine knurl rim. Overall diameter 13/16 in. 9/32 in. high. 3/8 in. threaded opening

1266. Octagonal tube cap, 5/8 in. overall diameter. 9/32 in. high 3/8 in. threaded opening

1267. Octagonal tube cap. 3/4 in. overall diameter. 11/32 in. high. 1/2 in. threaded opening

1268. Octagonal tube cap with fine knurl rim. Overall diameter 7/8 in. Height is 5/16 in., 9/16 in. threaded opening

Process anneals of mold steels

by E. K. SPRING and J. K. DESMOND*

PROCESS annealing as defined by the American Society for Testing Materials is "heating iron base alloys to a temperature below or close to the lower limit of the critical temperature range followed by cooling as desired." The annealing method, generally recommended and followed in the Plastic Industry, is to pack a partially sunk die in some protective substance, heat within the range 1500 deg. F. to 1600 deg. F., and cool slowly in the furnace. We hope to show that only an annealing temperature in excess of the critical range, such as 1695 deg. F., allows maximum continuance of hobbing, but also that short-time, low temperature process anneals in the neighborhood of 1200 deg. F. to 1250 deg. F. are effective, and may, for various practical reasons, be more satisfactory than the higher temperature of 1695 deg. F. and the temperatures commonly used in the industry.

The material tested in our work was a hobbing iron marketed under the name of *Distron Plastiron*, melted in an electric furnace to the following typical analyzer.

C	Mn	Si
0.10 max.	0.20	0.15

This material was subjected to successive hobbings and annealings in an effort to determine the response to annealing temperatures ranging from 1100 deg. F. to 1695 deg. F. Originally, cylindrical disks of the hobbing irons surrounded with a retaining ring were tried. As a result of the first hobbing, the disks were expanded to a force fit in the retaining ring. Hence, in the initial operation there was a greater degree of freedom of flow of the metal than in subsequent hobbings when the test block became a tight fit in the ring. Furthermore, the Plastiron is very soft and easily scored when ejected from the ring, which also affected the accuracy of subsequent determinations. These difficulties were overcome by using rectangular blocks 2 in. by 2 in. by 8 in. without the customary retaining ring. The pieces were cut from annealed bars 8 in. wide by 2 in. thick. The Rockwell hardness of this material was 2.5–10 G Scale (80–90 Brinell number).

The hob was made of Mansil Oil Hardening Steel:

C	Mn	Si	W	Cr
0.95	1.10	0.30	0.50	0.50

It was heat treated from 1525 deg. F. into oil and drawn at 380 deg. F. to Rockwell C 62. The dimensions were 2.250 in. long and 0.625 in. round, tapering in 1.750 in. of length to 0.250 in. round on the end. The shape of the hob itself was a matter of compromise. The obvious difficulty of extricating and re-introducing a hob without clearance directed the use of a tapered hob, although a cylinder would have been preferable for holding the pressure-to-area relationship constant and for proportioning results from the separate hobbings.

Before service, the hob was coated with copper sulphate. Side trials, however, failed to show the merit of copper sulphate as a lubricant coating. An average of ten separate test sinkings slightly favored the uncoated hob as far as depth of hole was concerned. Incidentally, a danger to the finished die may be incurred with the use of copper sulphate. During hobbing, the die itself may pick off copper from the hob. This copper on the die must be removed before carburizing or soft spots will be present on the surface after hardening due to the protective effect of the copper film against the entry of carbon from the carburizer.

The actual hobbing was accomplished with a Baldwin-Southwark universal testing machine by lifting the ram against the head to obtain compression. The use of this machine permitted not only exact control of the loads applied (200, 300 and 400 tons per sq. in.) but also a uniform rate of application—in our case 10 tons per second. The block to be hobbed was set on the traveling head. A guide plate for the hob 2 in. wide by 3/4 in. thick by 8 in. long with three 0.625 in. diameter holes spaced 2 in. apart was placed on top of the hobbing material. Separate sinkings 2 in. apart were made so that each block sustained three different loads. Several blocks were cut lengthwise to obtain Rockwell readings in the stressed areas.

Physical measurements were taken by micrometer from the bottom of the block to the top of the hob. By subtraction, these measurements gave the depth the hob sank after each hobbing operation. Table 1 shows these depths taken after the initial hobbing and two re-hobbings after process annealing at various temperatures and different times at those temperatures.

With the exception of the very low 1100 deg. F. process anneal, the data in Table 1 show that no improvement in hobbing qualities is obtained by lengthening the time at annealing temperature from two to ten hours. According to one accepted explanation of the

* Metallurgist and Sales Metallurgist, respectively, Henry Disston & Sons, Inc.

TABLE 1. HOBBING EXPERIMENTS ON PLASTIRON BLOCKS ANNEALED AT 1695 DEG. F.

Hobbing Pressure, Tons/Sq. In.	Depth of 1st Hobbing, In.	Temperature, Re-anneal ° F.	Time at Temp., Hrs.	Depth of 2nd Hobbing, In.	Depth of 3rd Hobbing, In.	Total Depth of 2nd and 3rd Hobbings, In.
200	0.167			0.044	0.042	0.086
300	0.262	1100	2	0.179	0.122	0.301
400	0.615			0.357	0.221	0.578
200	0.172			0.071	0.066	0.137
300	0.287	1100	5	0.214	0.138	0.352
400	0.610			0.357	0.208	0.565
200	0.167			0.084	0.079	0.163
300	0.275	1100	10	0.225	0.163	0.388
400	0.606			0.415	0.248	0.633
200	0.160			0.136	0.110	0.245
300	0.292	1200	2	0.288	0.206	0.494
400	0.605			0.463	0.387	0.850
200	0.155			0.125	0.092	0.217
300	0.295	1200	5	0.287	0.192	0.479
400	0.610			0.464	0.307	0.771
200	0.155			0.130	0.090	0.220
300	0.292	1200	10	0.286	0.193	0.479
400	0.615			0.478	0.350	0.828
200	0.153			0.142	0.077	0.229
300	0.295	1300	2	0.290	0.212	0.502
400	0.592			0.485	0.350	0.835
200	0.161			0.139	0.085	0.224
300	0.298	1300	5	0.292	0.212	0.504
400	0.585			0.470	0.337	0.807
200	0.155			0.142	0.098	0.240
300	0.285	1300	10	0.270	0.200	0.470
400	0.595			0.475	0.355	0.830
200	0.152			0.135	0.110	0.245
300	0.325	1400	2	0.228	0.198	0.426
400	0.592			0.455	0.358	0.813
200	0.155			0.137	0.094	0.231
300	0.340	1400	5	0.261	0.250	0.511
400	0.565			0.465	0.404	0.869
200	0.174			0.130	0.096	0.226
300	0.334	1400	10	0.303	0.271	0.574
400	0.612			0.495	0.373	0.868
200	0.174			0.127	0.124	0.251
300	0.358	1500	2	0.342	0.260	0.602
400	0.540			0.455	0.452	0.907
200	0.157			0.123	0.113	0.236
300	0.380	1500	5	0.308	0.285	0.593
400	0.545			0.579	0.467	1.046
200	0.170			0.153	0.100	0.253
300	0.360	1500	10	0.320	0.276	0.596
400	0.580			0.570	0.455	1.025
200	0.157			0.158	0.120	0.278
300	0.380	1695	2	0.350	0.295	0.645
400	0.615			0.591	0.568	1.159
200	0.165			0.145	0.118	0.263
300	0.362	1695	5	0.355	0.325	0.680
400	0.669			0.543	0.490	1.033
200	0.172			0.151	0.115	0.266
300	0.349	1695	10	0.335	0.320	0.655
400	0.585			0.582	0.543	1.125

effects of severe cold deformation, straining the Plastiron by hobbing causes fragmentation of existing grains into small particles. The greater the applied pressure, the greater the number of fragments produced. At low annealing temperatures, in or below the critical range, these fragments serve as nuclei capable of growing into large grains. Where the nuclei are many, the grains become enlarged, but relatively much larger grains are formed in the lesser strained areas where the number of nuclei is less. An annealing time which will permit the nuclei to develop into grains of maximum size, in consideration of the number present, is evidently sufficient, and prolonging the time at temperature will not result in increased benefit.

Fig. 1 shows a block of Plastiron strained with 200, 300 and 400 tons per square inch loads and cut in half lengthwise. All photographed specimens were etched in a 20 percent solution of ammonium persulphate. No anneal was given this specimen after hobbing. Rockwell readings G Scale under the cavitities are, from left to right, 65, 68 and 74, decreasing to a minimum value of 2.5 to 4, as the Rockwell hardnesses are taken progressively away from the bottom of the cavity toward the base as shown in Table 2. The area of greatest strain in the hobbed block, therefore, is near the bottom of the cavity where the values for Rockwell hardness are highest and the strain decreases in intensity away from the impressions. Similar observations on blocks annealed at three different temperatures after hobbing are also shown in Table 2.

TABLE 2. EFFECT OF ANNEALING TEMPERATURE ON HARDNESS OF METAL UNDER CAVITIES HOBBED AT VARIOUS PRESSURES

Location of Hardness Measurement	Rockwell G* Scale Readings after Various 2-Hr. Annealing Treatments			
	Unannealed	Annealed at 1200° F.; Air Cooled	Annealed at 1500° F.; Air Cooled	Annealed at 1695° F.; Furnace Cooled
Under cavity, hobbed at pressure of 200 tons per sq. in., at approximately 1/8 in. spacings toward base	65	5	2.5	2.5–4
	58	7	4	2.5–4
	44	8	3	2.5–4
	31	6 Crescent	3 Crescent	2.5–4
	18	19	7	2.5–4
	13	20	7	2.5–4
	6	17	5	2.5–4
	3	12	2.5	2.5–4
Matrix Block	2.5	10	2.5	2.5–4
	2.5	8	2.5	2.5–4
Under cavity, hobbed at 300 tons per sq. in., at approximately 1/8 in. spacings toward base	68	10	7	2.5–4
	61	12	7	2.5–4
	49	10	10	2.5–4
	41	4 Crescent	2.5 Crescent	2.5–4
	34	15	14	2.5–4
	23	14	12	2.5–4
	15	12	10	2.5–4
	6	10	8	2.5–4
Matrix Block	4	8	6	2.5–4
	4	4	4	2.5–4
Under cavity, hobbed at 400 tons per sq. in., at approximately 1/8 in. spacings toward base	74	16	7	2.5–4
	63	15	5	2.5–4
	50	10	7	2.5–4
	38	6 Crescent	3 Crescent	2.5–4
	30	20	18	2.5–4
	25	20	16	2.5–4
	21	17	15	2.5–4
	19	12	12	2.5–4
	7	10	10	2.5–4
Matrix Block	2.5	8	8	2.5–4

* 1/16 in. ball, 150 kg. load.

Fig. 1

Fig. 2

Fig. 3

Fig. 2 shows a similar block process annealed at 1200 deg. F. for two hours after hobbing. Large grain crescents have developed at a distance which apparently is a function of the pressures. Rockwell readings made between the crescent and impression, the area which includes the greatest strain, have dropped to within 4 to 14 points (a slight difference on the G Scale) of the original hardness of the block. On the large grain crescent the hardness is now practically the same as the matrix. Outside the crescents the hardness values jump above those obtained within the rings, but are, in general, under the readings on the block which was not annealed after hobbing.

The effect of the more commonly used annealing temperature of 1500 deg. F. is shown in Fig. 3. The large grain area develops into a somewhat wider crescent than for the 1200 deg. F. anneal. As the temperature was raised areas of lower strain have been incorporated into the crescents. Rockwell readings show the areas within the crescent to be 3 to 10 Rockwell G points softer than the (*Please turn to page 84*)

Speed nut assembly system

WITH the number and variety of applications for plastics constantly expanding there are an ever-increasing array of assembly problems. These arise particularly where a fabricated or molded plastic part serves as a part of an assembly.

Assembling methods, representing an important part of manufacturing costs as they do, are receiving increasingly close scrutiny. The types of devices which are finding application in the assembling operations are many. The speed nut is one of the most efficient.

Before the advent of the speed nut system, it was common practice to fasten molded plastic parts by means of threaded inserts, molded into the assembly part. With the development of the first standard speed nut as an assembly means, threaded inserts were no longer necessary because it was then practical to provide simple integrally molded studs for application of these devices as the sole fastening means. This simplified the molding process as well as eliminating the cost of screw machine parts.

The speed nut is an arched spring-steel fastening device with cam-like prongs to grip these integrally molded studs and hold tight as shown in Fig. 1. The speed nut is assembled by means of a tool that presses it over the stud and flat against the assembled part without touching the prongs (Fig. 2). As the tool is released, the nut springs back to within 30 percent of its original arch—causing the prongs to bite firmly into the stud. This provides a positive and permanent spring tension lock.

Removability. In many cases, removability was found desirable. This was accomplished by molding "D" shaped studs and using a speed nut with modified prongs. The nuts are applied with sides of prongs parallel to flat side of stud. Disassembly then merely requires a quarter turn of the nut.

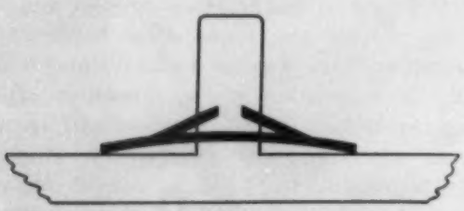

Fig. 1

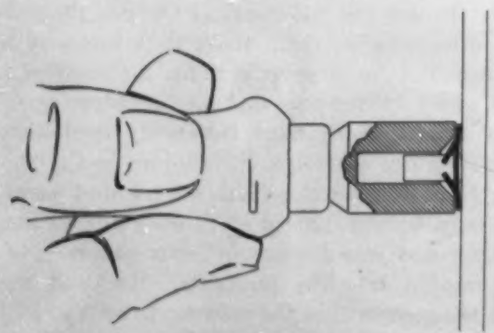

Fig. 2

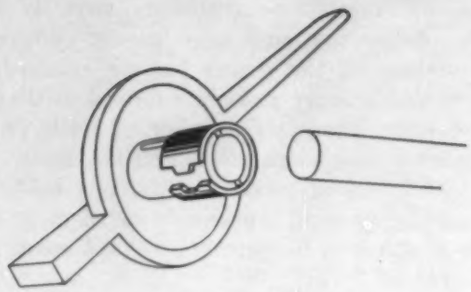

Fig. 3

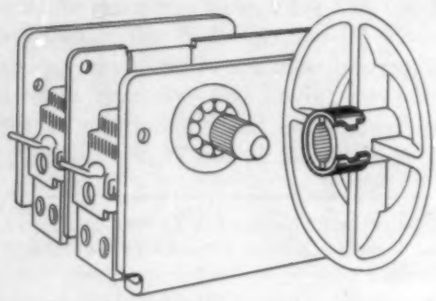

Fig. 4

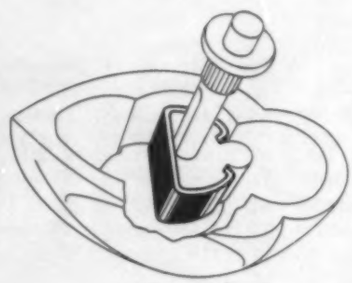

Fig. 5

The next major development in plastic assemblies was the speed clip designed for assembling thermoplastic knobs and dials. This is a spring-steel ring which compresses a slotted or split hub, thereby reducing the diameter of the hub opening. As the hub is pressed over the shaft, the spring compression of the speed clip prevents cold flow by holding the hub with metal on both sides of the plastic (Fig. 3).

In assembly of tuning dials or indicators where a positive setting is required, a serrated shaft or a "D" shaped hub is used, as shown in Fig. 4.

Where hardened or thermosetting knobs are used, another type of clip was developed to prevent hub cracking. This design allows for a rigid hub portion with one open side over which the clip is placed. In assembling, the flat side of the clip, frictionally engages the shaft, relieving the hub of any strain (Fig. 5).

Many types of tubular speed clips have been de-

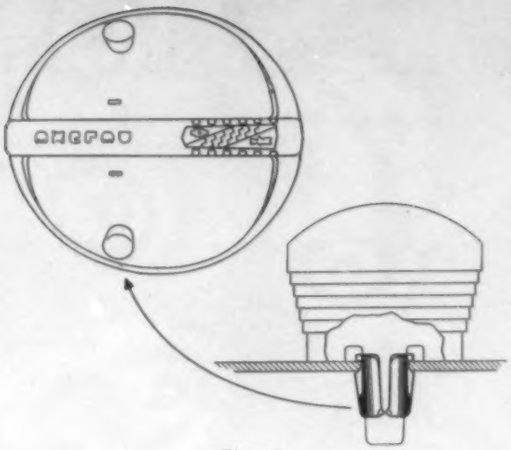

Fig. 6

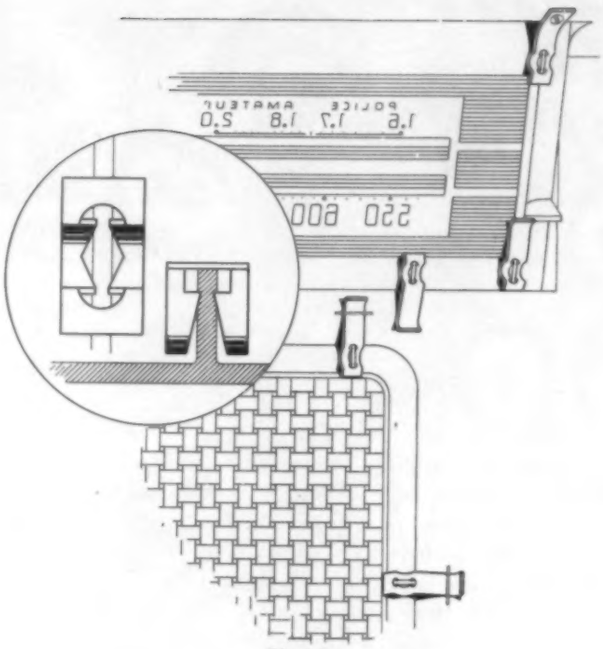

Fig. 7

veloped to fasten plastic parts to body panels. In Fig. 6, the handles on this automobile heater have integral plastic studs and are fastened with a device of this class. It eliminates threaded inserts, simplifies molding and reduces assembly costs. After the clips are snapped into holes in the heater doors, the studs of the handles are pressed into the clips. The contractular spring tension of the clips prevents loosening from vibration and strengthens the plastic stud by giving it a steel collar.

Another speed clip manufactured, presents a still different method of fastening plastics with integral ribs. Made of high-carbon spring steel, this clip is so formed that when pressed over a rib, the four sharp points bite into the sides of the rib to hold securely in place. The long retaining arm of the clip serves to hold an accompanying object firmly under spring tension. In many cases where thin sections of thermoplastic parts are used, it has been found that studs of a greater cross sectional volume than the surface to which they are molded, caused a dimple or shrinkage on the surface opposite the stud. This new device makes possible a fastening means that can be used on individual or continuous ribs (Fig. 7). These ribs can be of a thickness equivalent to the thickness of the surface to which they are molded, thereby providing perfect molding characteristics. Very often reinforcing ribs that are normally used to provide rigidity and uniformity of the molded part may be employed also as fastening ribs with the speed clip. In this way, extra tooling for special fastening bosses is eliminated.

A spring-steel speed clip with an integral tab holds the glass lens to a radio dial bezel (Fig. 8). When the clip is pressed over an integrally molded stud of the plastic bezel, the spring tab resiliently holds the glass. The curled-in corners of the clip bite into the stud to firmly lock the assembly.

Many different types of speed nuts are made to perform multiple functions besides eliminating two or more parts. In a radio plastic coil-form assembly (Fig. 19) one speed nut does three jobs. It fastens adjustment screw and core to coil, provides a frictional tension for core screw adjustment and fastens the entire assembly to the radio chassis. Assembly stages are shown below. (1) compressing ends for screw insertion; (2) clamping speed nut over plastic coil form; and (3) snapping the entire assembly into the radio chassis.

Credits: Speed nuts and clips, by Tinnerman Products, Inc.

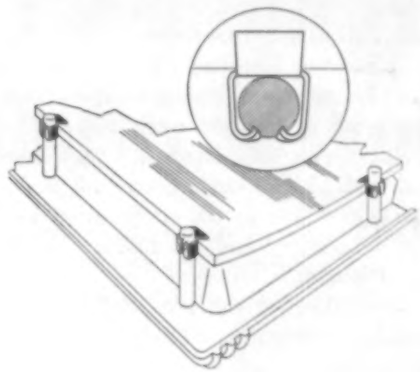

Fig. 8

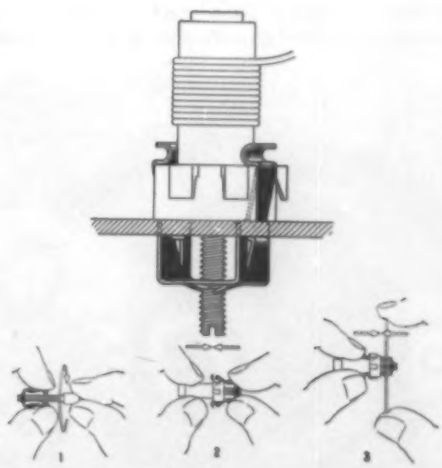

Fig. 9

Phenolic with cottonseed hulls

A new molding compound from a molder's viewpoint

by CHRIS. VAN DEVENTER, III*

THE project at the Cotton Oil Laboratory of the University of Tennessee looking toward the introduction of cottonseed hulls as fillers in phenolic molding compounds has been prompted by the urge to find better uses for cottonseed hulls which have been used heretofore only as roughage for beef and dairy cattle. The program was carried out along three separate lines: laboratory research, pilot plant development, and commercial molding.

The laboratory study investigated the effect of particle size and fiber content of cottonseed hull fillers on mechanical strength (impact, flexural, modulus of elasticity) of molded phenolic compounds. Additional information with respect to the interior structure was obtained from microphotographs taken from polished cross sections of molded test bars containing cottonseed hull fillers of various particle sizes and fiber contents. Maximum impact and flexural strength data were obtained at specific particle sizes and fiber contents. These results were presented recently by Dr. Fritz Rosenthal in a paper before the American Chemical Society (see abstract on page 75 of the May 1941 issue of MODERN PLASTICS).

A pilot plant was installed which turned out 110-lb. batches of phenolic resin impregnated cottonseed hulls. These pilot plant batches were given to National Plastics, Inc., who submitted the compound to the "practical test." The cottonseed hull molding compound developed due to the cooperation between the University laboratory and the molder has been given the name "*Plastone*."

Examples of typical parts molded of this phenolic-cottonseed-hull compound are shown in Figs. 1 to 3.

* National Plastics, Inc.

Housing, tube shields and cross arms of this inexpensive centrifuge are molded of phenolic cottonseed hull plastic

1

2

Precision sheaves and pulleys of molded plastic replace wood and stamped metal for textile machinery. Typical assembly of 25 sheaves for Crompton head is at top left. Others are single and double flange type

Fig. 1 shows a complete inexpensive centrifuge. The housing, tube shields and cross arms are molded from plastone for the Wilmar Co., Hickory, North Carolina. Quite a number of universities in this country already have them in use.

Sheaves molded of this compound are shown in Fig. 2. These are a definite improvement in the art of weaving for the textile industry. These sheaves are taking the place of wood and stamped metal. Metal inserts are Johnson Bronze's Ledaloyl or Chrysler's Oilite bearings that are porous and contain plastic petroleum or oil that does not drip onto the cloth being woven on the loom. They have been running for 24 hours per day since April 10, 1940, without a single reported failure. They are installed in sixty-odd mills.

The properties of this new molding compound may be summarized as follows.

FLOW. For the present, the flow of "*Plastone*" may be classified as follows:

Soft Short	Soft Medium	Soft Long
Med. Short	Med. Medium	Med. Long
Hard Short	Hard Medium	Hard Long

This, it is believed, will afford a quick and simple means of identifying its flow characteristics. As yet there is a need for producing only two flows—Hard short and Medium long.

PREFORMING: In the lower bulk factors, preformability is good, but, so far, best results have been had by adding the bulk material direct to the mold cavity unless preheating is used. (*Please turn to page 96*)

Tenite handles molded by The Ohio Plastic Company for The Union Fork and Hoe Company.

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This year, garden tools appear with Tenite handles—always a popular material for new plastic developments.

Tenite was selected for these handles because of its durability, lustrous color, and pleasant feel. It withstands varying weather conditions and hard use without cracking or splintering—its bright color cannot chip, peel or wear off. Because Tenite has low heat conductivity, the handles will not become excessively hot from the sun's rays. Their smooth surface will not blister or corrode.

Excellent molding properties and a wide range of physical properties have made Tenite a favorite choice for handles of all types, including saws, wrenches, chisels, fuse testers, kitchen utensils, door knobs and window regulators. A 28-page illustrated book on Tenite and its uses will be sent on request.

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Plastics digest

This digest includes each month the more important articles (wherever published) which are of interest to those who make plastics materials or use them. Requests for periodicals mentioned should be directed to the individual publishers.

General

PLACE OF PLYWOOD, PLASTICS, AND CORROSION - RESISTANT STEEL IN AIRCRAFT CONSTRUCTION. T. H. Huff. Iron Age *147*, 43–6 (Apr. 10, 1941). Problems involved in the introduction of new materials into aircraft construction are discussed. A lack of background of service tests and of government specifications covering aircraft parts of plastics makes the industry hesitant to assume the full burden of responsibility for the use of these materials. Parts representing about 5 percent of the total airframe cost could be molded of plastics. These include ammunition boxes, bomb and pyrotechnic installation parts and controls, control wheels and quadrants in the fuselage, engine ring cowling flaps, various equipment items for navigation, radio, photography, and fire control, supports and brackets for the oil and fuel systems, tabs for the elevators, rudders, and ailerons, and heating and ventilating equipment ducts.

INSULATION. H. Warren. J. Inst. Elec. Eng. *87*, 588–96 (Dec. 1940). Progress in the manufacture of electrical insulation of improved characteristics from synthetic resins and woven glass, respectively, is summarized. The following data are cited for various types of insulators as determined at a frequency of 1,000,000 cycles and at 20 deg. C.

	Power factor	Dielectric constant
Wood	.036	2.9
Hard rubber (loaded)	.0095	2.8
Hard rubber (unloaded)	.01 –.035	2.5–4.5
Phenol-formaldehyde resin	.022	2.8
Aniline-formaldehyde resin	.011	3.7
Polystyrene	.0004–.00045	2.1–2.3
Mica	.00018	7.0
Mica - glass (Mycalex)	.002	7.5
Quartz	.0001	4.7
Porcelain	.0063	5.4
Steatite	.002	6.5
Rutile (TiO_2)	.0003–.0006	40–80

WHAT ABOUT PLASTIC AIRPLANES? S. M. Fairchild. Aero Digest *38*, 132–3, 250 (May 1941). The development of Duramold is reviewed and the particular problems which are now receiving attention are outlined.

PLASTICS FROM LIGNIN AND WOOD. G. H. Tomlinson. Pulp and Paper of Canada *42*, 91–2+ (Convention No., Feb. 1941). A summary of recent publications and experimental work in this field is presented.

Materials and Manufacture

ISOFLEX. British Plastics *12*, 217–8 (Dec. 1940). Isoflex is the trade name of a thermal insulation material made up of cellulose acetate corrugated sheets. It is not suitable for use above 75 deg. C. It is of unusually low density and is constructed so as to permit free drainage of condensed moisture. The thermal conductivities in B.T.U.'s per sq. ft. per hr. for 1 in. thickness and 1 deg. difference in Fahr. temperature and the weights in lb. per cu. ft. of Isoflex and other thermal insulating materials are as follows:

	Conductivity	Density
Isoflex	0.32	0.75
Slab cork	0.25	6.0
Expanded ebonite	0.19	4.0
Glass fiber	0.28	...
Wood fiber board	0.38	...
Slag wool	0.29	15.0
Diatomaceous earth	0.56	30.0

PLASTICIZERS. F. W. Clark. Chemistry and Industry *60*, 225–230 (Apr. 5, 1941). Types of plasticizers useful with various plastics are reviewed. The theory of plasticizer action is considered by several commentators in the discussion.

PLASTICIZERS FOR CELLULOSE ORGANIC ESTER PLASTICS. W. E. Gloor and C. B. Gilbert. Ind. and Eng. Chem. *60*, 597–601 (May 1941). Spatial structure and substitution of the plasticizers are important factors in determining their effectiveness in cellulosic thermoplastics. Essential features of the structure of tough and brittle plastics are shown by diagrams.

CAST PHENOLIC RESINS. W. R. Thompson. Chemical Industries *48*, 450–6 (April 1941). The manufacture of the special grade of phenol-formaldehyde resin used in casting is described. The relation of composition to Rockwell hardness, tensile strength, specific gravity, compressive strength, and impact strength is discussed. The coloring of cast resins and their various applications are considered.

Molding and Fabricating

EJECTION PINS FOR MOLDS. British Plastics *12*, 279–86 (Feb. 1941). The design and maintenance of ejector pins attached to a moving ejector plate are surveyed. Means for proper lubrication of these pins are set forth.

INJECTION MOLDING. M. L. Macht, W. E. Rahm, and H. W. Paine. Ind. and Eng. Chem. *33*, 563–7 (May 1941). Various types of injection molding machines are described and illustrated. A brief comparison of the costs of injection and compression molding is given.

Applications

FYBR-TECH, A NEW MATERIAL FOR AIRPLANE CONSTRUCTION. J. R. Fitzpatrick. Aero Digest *38*, 175–6 (May 1941). Fybr-Tech consists of vulcanized fibre faces bonded to a veneer or plywood core with synthetic resin. Hollo-Tech has a hollow core construction and is particularly adaptable for cabin floors, bulkheads, and doors.

PLASTICS IN PACKAGING. Modern Packaging *14*, 64 + (May 1941). Developments in packaging in plastic containers under present emergency conditions are reviewed.

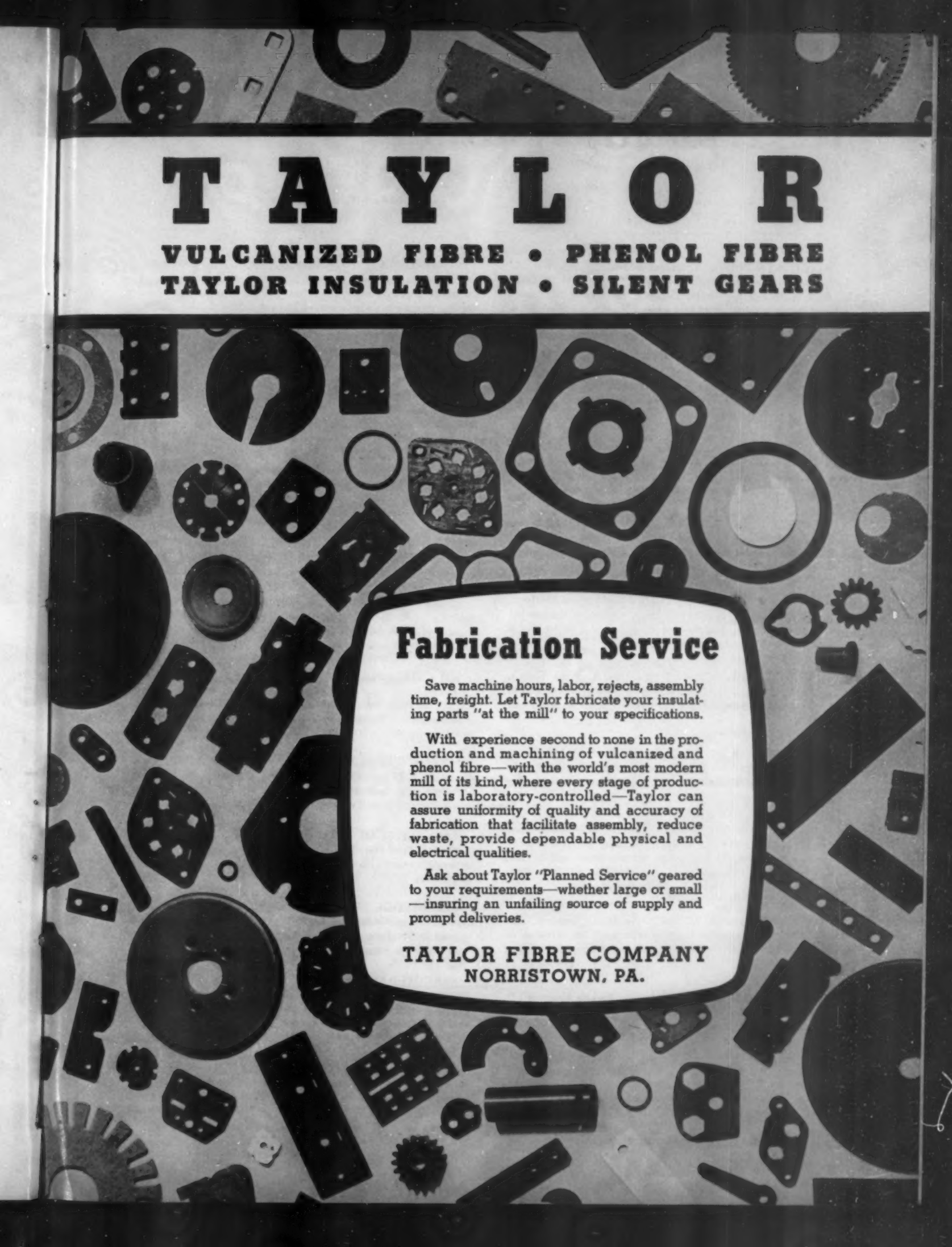
TRENDS IN THE USE OF RESINS IN FINISHING. R. W. Jacoby. American Dyestuff Reporter *30*, 170–8 (Mar. 31, 1941). A review.

FORMING AND MOUNTING ACRYLIC PLASTICS. D. S. Frederick. Aero Digest *38*, 195–6 (May 1941). Transparent enclosures for aircraft are described and illustrated. Special mounting problems are discussed.

Properties and Testing

A SIMPLE FLEXURE-TESTING MACHINE FOR PLASTICS. G. H. Brother, W. C. Suttle, and L. L. McKinney. A.S.T.M. Bulletin, *1941*, 13–16 (Mar.). A flexural testing machine of 500 lbs. capacity, built with a pendulum-type dynamometer and weighing only 230 lbs., is described and illustrated.

RESISTANCE OF PLASTICS TO WATER AND CHEMICAL REAGENTS. Plastics *5*, 60–1 (Mar. 1941). Experimental data published by A. D. Sokolov and his colleagues in the Transactions of the Symposium of the Academy of Sciences of the U.S.S.R. on Organic Chemistry, 1939, are abstracted.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TRIACETATE FOILS. K. Nagel, J. Sieb, L. Scheffer and K. Werner (to Chemical Marketing Co.). U. S. 2,236,648, April 1. Acetylating cellulose to the triacetate, inactivating the catalyst and sheeting the product into a coagulating bath of aqueous acetic acid.

LINING WELL BORES. C. F. Prutton (to Dow Chemical Co.). U. S. 2,236,836, April 1. Lining a well bore with a resin solution which deposits resin in the surrounding formation and lines the bore with solid resin; and forming flow channels through the resin by action of an explosive.

POLARIZING SHEET. Erwin Käsemann. U. S. 2,236,972, April 1. A transparent sheet of colloidal cellulose hydrate contains complementary dyes, with their molecules attached to the oriented cellulose micelles to give a neutral gray color.

GELATIN FILMS. K. Thinius (to Walther H. Duisberg). U. S. 2,237,017, April 1. Cementing a gelatin layer to a vinyl chloride resin support with an interlayer of vinyl chloride interpolymerized with a vinyl or acrylate ester.

MOLDED DISHES. Wm. W. Carter (to Brayton Morton). U. S. 2,237,048, April 1. Making dishes from pulp impregnated with a synthetic resin and molded in such a way as to give a smooth enamel-like resin surface.

WRAPPING FOIL. C. W. Walton (to Wingfoot Corp.). U. S. 2,237,125, April 1. Neutralizing free hydrochloric acid in rubber hydrochloride, removing the neutralization products and forming a foil.

INLAY EFFECTS. J. J. Larmour (to Plastic Inlays, Inc.). U. S. 2,237,152, April 1. Inlaying ornaments in synthetic resin articles by heating the resin through the ornament and tapping the ornament to embed it in the resin.

SURGICAL TUBING. V. J. Flynn (to Wardlyn Corp.). U. S. 2,237,218-9-20-1-2, April 1. Making surgical tubular devices of water-insoluble cellulose ethers, plasticized or not, which are highly etherified with the same or different ether radicals; or of highly esterified mixed esters of cellulose.

COATING WIRE. J. H. Reilly (to Dow Chemical Co.). U. S. 2,237,315, April 8. Coating wire with an emulsion of vinylidene chloride in trichlorobenzene and baking the coating on the wire.

ACETONE RESIN. E. H. Balz (to Plaskon Co.). U. S. 2,237,325, April 8. Alkaline condensation of acetone with formaldehyde to form a resin which will set without evolving gas.

POLARIZER. E. H. Land (to Polaroid Corp.). U. S. 2,237,567, April 8. A light polarizer comprising a sorption complex of a dichroic stain on a molecularly oriented vinyl alcohol resin.

MODIFIED PHENOLIC RESIN. R. Rosen (to Standard Oil Development Co.). U. S. 2,237,634, April 8. Condensing an aromatic petroleum hydrocarbon with an aldehyde, and condensing the product with a phenol and a quantity of aldehyde.

CONTACT LENS. John E. Mullen. U. S. 2,237,744, April 8. Shaping a plastic contact lens by machining a blank to the desired curvature with a turning tool used with a curve generator.

CORK COMPOSITION. C. Dangelmajer and E. S. Peierls (to Resistoflex Corp.). U. S. 2,237,753, April 8. A flexible, resilient, oilproof and gasolineproof cork composition having polyvinyl alcohol and a high-boiling oil as the binder.

INTERPOLYMER. A. W. Hanson and Wm. C. Goggin (to Dow Chemical Co.). U. S. 2,238,020, April 8. Interpolymerizing vinylidene chloride with acrylonitrile or methacrylonitrile in weight ratios ranging from 1:19 to 19:1.

ALLYL ESTER RESIN. T. F. Bradley (to American Cyanamid Co.). U. S. 2,238,030, April 15. Interpolymerizing diallyl fumarate with vinyl acetate to form an insoluble, infusible resin.

PILE FABRIC. H. Bradshaw (to E. I. du Pont de Nemours and Co.). U. S. 2,238,098, April 15. Making the ground threads of a pile fabric of linear polyamide filaments, shrunk *in situ* to make the pile denser.

SOY CASEIN PLASTIC. G. H. Brother and L. L. McKinney (to Secretary of Agriculture of the U. S.). U. S. 2,238,307, April 15. A thermoplastic molding composition is made from a globular protein by reaction with an aldehyde, not higher than butyraldehyde.

SHOE STIFFENER. H. S. Miller (to Beckwith Mfg. Co.). U. S. 2,238,337, April 15. A sheeted thermoplastic for shoe stiffeners contains rubber 130, resinous box toe scrap 400, coumarone resin 100 and asbestos fiber 200 parts.

PACKAGE SEAL. T. A. Riehl (to Wingfoot Corp.). U. S. 2,238,342, April 15. Sealing a rubber hydrochloride wrapper by pressure contact with a hot plate coated with a nonadhesive such as paraffin.

PREHEATER. Arthur P. Summerfield. U. S. 2,238,378, April 15. An electrically heated oven for preheating thermosetting molding compositions is fitted with sliding trays having wire gauze bottoms.

STRUCTURAL ELEMENT. Alfred Schmid. U. S. 2,238,427, April 15. Joining a bundle of cellulose derivative tubes together by cementing them together with a cellulose derivative solution along their lines of contact.

POLYMERIZER. C. M. Fields (to E. I. du Pont de Nemours and Co.). U. S. 2,238,443, April 15. Apparatus for polymerizing organic compounds in rod or tube form by progressively immersing tubes, filled with the monomer, in a liquid bath.

(Please turn to next page)

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ILLUSTRATED LITERATURE MAILED UPON REQUEST

NITRATING CELLULOSE. W. H. F. Fravel (to Hercules Powder Co.). U. S. 2,238,444, April 15. Making methanol-soluble nitrocellulose, for lacquers, by nitrating cellulose with spent acid from a previous nitration, the spent acid being fortified to 20–30 percent nitric acid content.

OPACIFIED MOLDINGS. G. M. Kuettel (to E. I. du Pont de Nemours and Co.). U. S. 2,238,446, April 15. Wetting a methacrylate or styrene resin molding powder with water and molding to obtain opaque moldings.

POLYVINYL KETAL. S. C. Overbaugh (to E. I. du Pont de Nemours and Co.). U. S. 2,238,447, April 15. Combining at least 40% of the available hydroxyl groups of polyvinyl alcohol with 3,5-dimethylcyclohexanone.

TRANSPARENT TUBES. C. A. Cabell (to Economy Fuse and Mfg. Co.). U. S. 2,238,579, April 15. Transparent cellulose tubing with a glass core is formed by swelling a cellulosic material in water, shrinking it in successive layers on a glass tube, and finally winding foils of cellulosic material tightly around.

POLYMER. W. E. Hanford (to E. I. du Pont de Nemours and Co.). U. S. 2,238,640, April 15. Making a resin by action of formaldehyde on a polyamide-forming composition containing a diamine, a dicarboxylic acid and an amide-substituted phenol.

BOTTLE CAP. G. L. Dorough (to E. I. du Pont de Nemours and Co.). U. S. 2,238,681, April 15. A cushion liner for bottle caps is made of an ethylene polymer with molecular weight 6000 or higher.

VINYLACETYLENE AMIDE POLYMERS. H. B. Dykstra (to E. I. du Pont de Nemours and Co.). U. S. 2,238,682, April 15. A polymeric reaction product of free or substituted monovinylacetylene with a monoacylamide of an organic acid.

FAST-DRYING RESIN. C. Ellis (to Ellis-Foster Co.). U. S. 2,238,684, April 15. Condensing formaldehyde with urea in presence of an alkyl resin to form a soluble, fast-drying resin.

COLD DRAWN POLYMERS. G. D. Graves (to E. I. du Pont de Nemours and Co.). U. S. 2,238,694, April 15. Coating a synthetic polymer with a solid film and cold drawing the polymer beyond the cold drawing capacity of the coating.

ETHYLCELLULOSE. C. F. Wells (to E. I. du Pont de Nemours and Co.). U. S. 2,238,714, April 15. Ethylating cellulose, emulsifying the product in an organic solvent and precipitating the ethylcellulose by running the emulsion into vigorously agitated boiling water.

VINYL RESIN FOILS. Otto Hauffe (to Walther H. Duisberg). U. S. 2,238,730, April 15. Forming thin foils from high-melting vinyl or acrylate or acrylonitrile polymers or interpolymers by moistening the powder with a solvent and sheeting it on hot rolls.

PULP MOLDING DIES. E. L. Shepard (to Canal National Bank). U. S. 2,238,853, April 15. Forming pulp molding dies with perforate covers clamped in over the mold sections.

MAGNETIC CORE. E. Fischer (to Siemens und Halske Aktiengesellschaft). U. S. 2,238,893, April 22. A nonhygroscopic magnet core for induction coils in electric cable communication systems is made of ferromagnetic powder with a polystyrene binder.

BLEACHING CELLULOSE ETHERS. J. A. McHard and F. C. Peterson (to Dow Chemical Co.). U. S. 2,238,912, April 22. Bleaching water-insoluble ethers in aqueous suspension by adding sodium hypochlorite while keeping the pH on the alkaline side.

VINYL RESIN EMULSION. C. O. Stother (to Carbide and Carbon Chemicals Corp.). U. S. 2,238,956, April 22. As a coating composition a thixotropic solution of vinyl chloride: vinyl acetate interpolymer in a solvent:nonsolvent blend, emulsified in water.

MOLDING APPARATUS. Vincent B. Norelli. U. S. 2,239,338, April 22. A mold block is formed as a solid of rotation, with a mold cavity, an injection orifice and a discharge opening through which the moldings are removed.

MALONAMIDE RESINS. G. F. D'Alelio (to General Electric Co.). U. S. 2,239,440–1. April 22. Condensing an aliphatic aldehyde with malonic diamide, or with malononitrile or malonic thioamide.

MULTIPLE SAFETY GLASS. J. W. Kamerer (to Pittsburgh Plate Glass Co.). U. S. 2,239,527, April 22. Facing plate glass on both sides with plasticized vinyl acetal resin, bonding two thinner glass plates thereto, facing this assembly on both sides with a cellulose derivative interlayer and bonding two still thinner glass plates thereto.

SLIDE FASTENERS. G. H. C. Corner (to Talon, Inc.). U. S. 2,239,645, April 22. Improving adhesion of molded slide fastener members to the supporting tape by action of a solvent.

POLYVINYL ALCOHOL FOILS. E. F. Izard (to E. I. du Pont de Nemours and Co.). U. S. 2,239,718, April 29. Making transparent foils from polyvinyl alcohol, a water-insoluble amino polymer, a plasticizer and a moistureproofing agent.

HEAT-TREATING THERMOPLASTICS. H. Fikentscher and H. Jacque (to General Aniline and Film Corp.). U. S. 2,239,780, April 29. Improving the properties of polyvinyl chloride by heat, without pressure, in the temperature range 220–320 deg. C.

SLIDE FASTENER. Martin Winterhalter. U. S. 2,239,803, April 29. A fastener with spaced interlocking members molded on opposite sides of a pair of stringers, the interlocking projections and recesses being free of mold flash.

SANDPAPER. N. E. Oglesby (to Behr-Manning Corp.). U. S. 2,239,828, April 29. Heating a synthetic resin to spreading consistency, adding a cure accelerator, coating the resin on a backing and applying abrasive grit, then curing the resin.

TERPENE RESIN. E. G. Peterson (to Hercules Powder Co.). U. S. 2,240,006, April 29. Forming a rubbery gelled resin by reacting a terpene with maleic anhydride and condensing the product with a glycol.

ADHESIVE. F. S. Bacon (to Monsanto Chemical Co.). U. S. 2,240,027, April 29. A partial vinyl acetal resin solution, containing a plasticizer, is pigmented sufficiently to reduce cold flow without impairing adhesive properties.

CASHEW NUT SHELL RESIN. M. T. Harvey and F. M. Damitz (to Harvel Corp.). U. S. 2,240,038, April 29. Acid polymerization of cashew nut shell liquid followed by heat treatment to produce a resilient rubber-like polymer.

Publications

Write direct to the publishers for these booklets. Unless otherwise specified, they will be mailed without charge to executives who request them on business stationery. Other books will be sent postpaid at the publishers' advertised prices

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Plastics in Industry

by "Plastes"

Chemical Publishing Co., Brooklyn, N. Y., 1941
Price $5.00 **240 pages, 32 plates**

This complete text book was intended, as the authors state in their introduction, to lift the curtain of mystery from plastics for the industrialists of the world. They have attempted to do so by reporting miscellaneous plastic developments picked at random from the industry's evolution in England and in the United States.

In an era of realism when it isn't even fashionable for novelists to use a *nom de plume* it is difficult to understand why the authors (it is assumed there was more than one by your reviewer, according to the grammar of the text) sailed against the wind of their very own clarifying philosophical intentions and credited authorship to a mystical "Plastes."

The broad classes of thermosetting and thermoplastic materials have been defined for the lay reader. The various types of plastics have been enumerated and described. Some that are being commercially produced have not been included. In the discussion covering specifications, inasmuch as the book was for an international audience, the efforts of the American Society for Testing Materials D 20 Committee, the specifications of the Bureau of Ships, U. S. Navy, the Bureau of Standards and several private companies such as Bell Laboratories, Chrysler Rubber and Plastics Laboratory and certain General Motors Divisions might advisedly have contributed data of value. The American Industrialists who happen to be engaged in molding or extruding plastics would have welcomed a more detailed discussion on thermosetting extrusion. That the public is antipathetic toward plastic instrument panels or other interior plastic parts on their motor cars, as the authors remark, is not borne out of their increasing application on the 1941 models.

If the fact that 90 percent of all plastic toilet ware is made from Celluloid was predicated upon a world-wide figure the calculation is subject to revision. The wide application of molded methacrylates of fabricated methacrylate, of vinyl copolymers, and of polystyrene to articles which today flow through the channels of this trade have in recent years altered the picture.

The book should be of interest to those who are looking at the plastics industry for the first time. It will give such a reader an episodic, thumbnail sketch of the materials, the methods and the wares that go to make up the plastic industry. W. T. C.

A.S.T.M. Standards on Paint, Varnish, Lacquer and Related Products

Published by the American Society for Testing Materials, 260 South Broad St., Philadelphia, Pa., 1941

Price $2.00 **342 pages**

This pamphlet has been compiled to present in convenient form all of the A.S.T.M. specifications, methods of test, and definitions pertaining to pigments, drying oils and thinners, shellac, varnish and varnish materials, lacquer and lacquer materials, paint tests, putty, and miscellaneous products. The work of the American Society for Testing Materials in this particular field is conducted by Committee D-1 on Paint, Varnish, Lacquer, and Related Products. Information regarding the functions and personnel of the Committee are included in this publication. G. M. K.

★ CALCO CHEMICAL DIV., AMERICAN CYANAMID Co., Bound Brook, N. J., in conjunction with the celebration of its 25th anniversary, have issued an interesting 31-page study of the development of American dyestuff industry entitled, "Dyes Made in America." The book is by William Haynes, formerly publisher of *Chemical Industries*, and describes the early beginnings of Calco, how they succeeded by long experimentation to make aniline oil, beta naphthol and, finally such dyes as methylene blue, crimson and tartrazine. The book is illustrated with half tones of industrial production as well as natural color photos showing the application of American made dyes.

★ *"THE CHANGE TO PLASTICS,"* IS THE TITLE OF AN attractive new folder issued by the Plastics Dept. General Electric Co., Pittsfield, Mass., giving 12 case histories in which plastics have been used in making items formerly made of other materials. Cases discussed are the following: Safety Guard, Adding Machine Housing, Vacuum Cleaner Hood, Meat Chopper Housing, Magneto Case and Cap, Rocker Arms, Spools, Gears, Cams, Refrigerator Breaker Strips, and Bases.

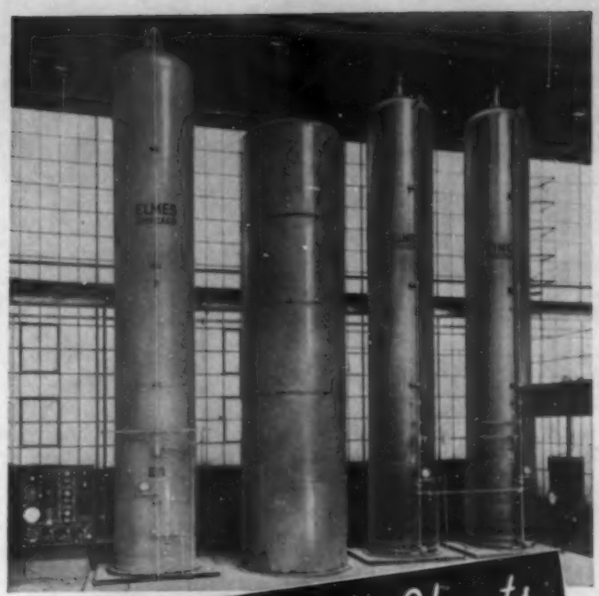
★ IMPETUS IS GIVEN IN THE TRAINING OF DEFENSE workers by the Emergency Defense Training Committee of the American Society of Tool Engineers, 1036 Book Bldg., Detroit, Mich., who have made available literature at cost which teach the following subjects: Heat treatment, job series, measurements, drill presses, bench work, blueprint reading, lathe operation and shop mathematics. The latter two are already available and milling machine and shaper operation courses will be available July 1st.

★ COPIES OF THE PROCEEDINGS OF THE TENTH Semi-Annual Eastern Photoelasticity Conference, comprising five papers on methods and equipment used in the study of stress distributions by polarized light, can be obtained at 75 cents per copy from W. M. Murray, Room 1-321, Massachusetts Institute of Technology, Cambridge, Mass.

★ LITERATURE REFERENCES ON LEVULINIC ACID IS the title of a bulletin issued by the Division of Research Development, A. E. Staley Manufacturing Co., Decatur, Ill. Among the 317 references are a group relating to the condensation of aldehydes with levulinic acid, which suggests interesting possibilities in the production of synthetic resins.

★ A NEW BOOKLET ON CELLULOSE ACETATE WAS recently issued by Hercules Powder Co., Wilmington, Del., giving data on properties, application and formulation of the material. The booklet contains tables on physical properties, film characteristics, solvents, resins, plasticizers, and properties of lacquer films. Charts of viscosity concentration curves, of water absorption of cellulose acetate plastics of varying acetylation, and a blending chart for different viscosities are given. The booklet also covers the application, formulation and spraying of cellulose acetate lacquers.

★ TRADE SCHOOLS AND COMPANIES WITH APPRENtice training programs are being aided by a series of blueprint charts on lathe practice released recently by Atlas Press Co., Kalamazoo, Mich. The three charts now available are: *Lathe Cutting Tools, Thread Forms and Formulas*, and *60° V-Type Thread Dimensions*. The charts measure 16¼ in. wide × 21 in. high and are printed on durable ledger paper. The three Atlas lathe charts are being offered for a limited time to industrial instructors and apprentice directors. When requesting the charts, enclose 10 cents in stamps to cover handling and mailing expense. Or the set will be sent free postpaid with each order for the Atlas *Manual of Lathe Operation*, a 272-page instruction book covering every phase of modern lathe work ($1.00 per copy in U. S. A.). Address Technical Service, Atlas Press., Kalmazoo.



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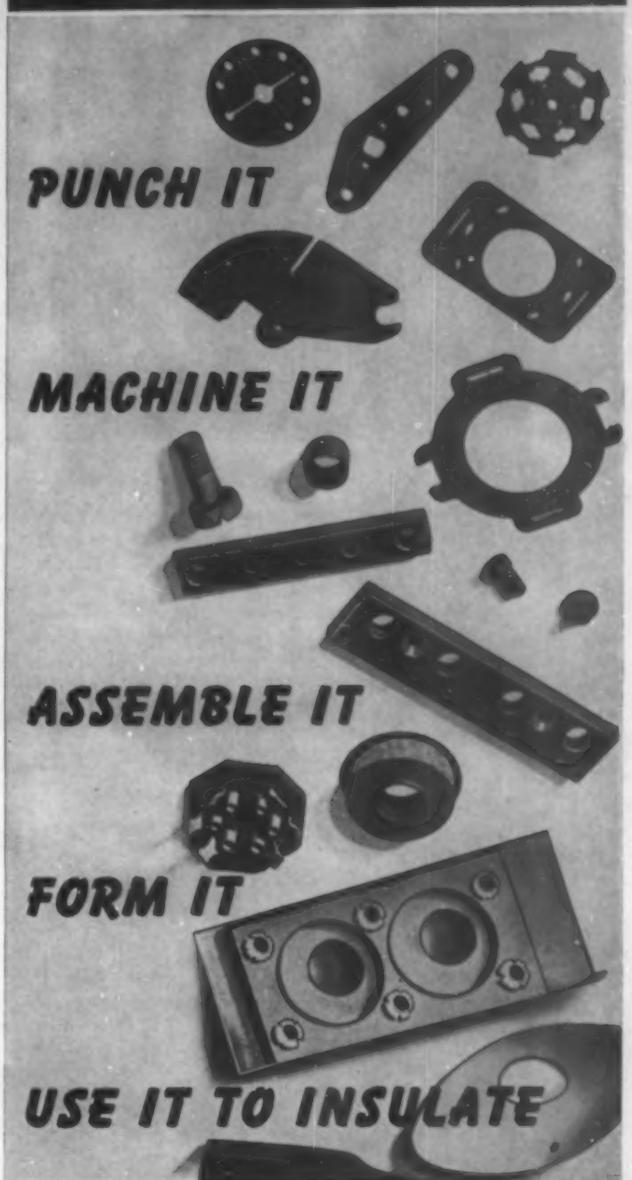

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Continental-Diamond FIBRE COMPANY

"Manufacturers of Laminated Plastics Since 1911"
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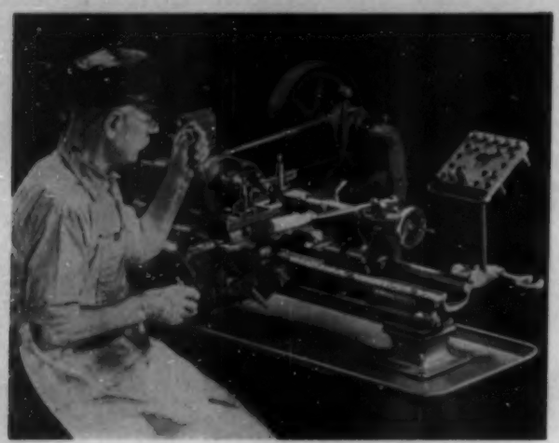
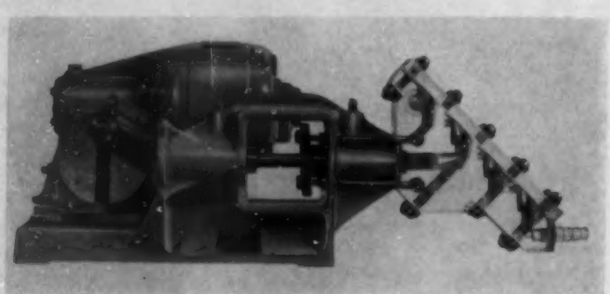
Machinery and equipment



★ A NEW MODEL—A 9-IN. SWING TOOL ROOM PRECISION lathe recently announced by the South Bend Lathe Works, is said to be adapted by its size and design for small diameter work requiring a high degree of accuracy and sensitivity. This lathe has a maximum collet capacity of 1/2 in., maximum swing over bed ways of 9 1/8 in., and a maximum swing over saddle cross slide of 5 1/2 in. Three bed lengths are available, providing center distances of 16 in., 22 in., and 28 in., respectively. It is made in floor type with pedestal motor drive, as illustrated, also in bench type with motor drive, and in both bench and floor types with countershaft drive.

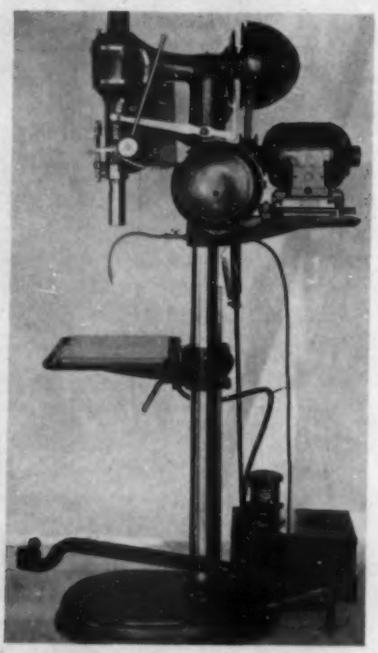


★ MILTON ROY PUMP FOR USE IN HANDLING DILUTE acids, hypochlorides and other chemicals features a transparent side section of Plexiglas (shown above). It is machined from a solid block of methyl methacrylate and shows the flow of liquid being pumped and the movement of the valve checks and piston at all times. The material is resistant to chemical attack. The inlet and outlet hose nipples are also of plastic construction. The pump has a capacity of 18 g. p. h. against maximum discharge pressure of 150 lbs. per sq. in. The valve contains all the characteristics and advantages of the standard step-type valve. Ready accessibility is provided by a flat-plate cover which, when removed, permits cleaning of the valve assembly without disturbing pipe connections to the pump.

★ ELASTIC STOP NUT CORP. ANNOUNCES THE DEvelopment of an improved line of thin hex nuts for use on shear bolts where a high degree of stress is lateral and for general application to light and medium stress fastenings. These self-locking fastenings are cleaned to offer savings in space requirements, weight and cost. As in the standard-height nuts, the self-locking action is accomplished by means of a vulcanized fiber collar which is built into the head of the nut. This tough bone-like material resists the entry of the bolt, thus forcing the nut outward and taking up all thread play. The fiber, being non-metallic and of a resilient character, does not deteriorate under vibration, and so continues to hold the threads of nut and bolt in a constant-pressure contact.

★ NEW TYPE IMPROVED SOFT RUBBER POLISHING wheel for creating highly polished surfaces on any base metal, is announced by Chicago Wheel & Mfg. Co. Five different types of polishing compound are impregnated in a special rubber binder according to the report, and in addition, there is sufficient cutting grit to remove scratches and grinding marks from the piece being polished. They are claimed to eliminate the use of set-up wheels on many operations.

No special equipment is required in using these soft rubber polishing wheels. They are available in a complete range of sizes including sticks and sheet form for hand lapping. Conventional dressing tools are used to dress the faces of wheels to any desired contour so that irregular shaped castings can be polished. It is said that any coolant, which is not a solvent of rubber can be used where it would be desirable. The material is not suitable for polishing plated work.



★ A NEW AND IMPROVED MODEL TAPPING MAchine, built for lightness, compactness, ease of handling and extremely moderate in cost, is announced by the Cleveland Tapping Machine Co. Streamlined and unique in design and principle of operation, this machine is claimed to have the ability to tap holes of different depths without changing the stop gage. This is done by means of a spacer hinged on the housing and made to contact the reversing lever. Another feature reported is the easy adjustment by conveniently arranged controls. The improved machine is 90 percent automatic—start the tap and it creates its own lead. A rigid spindle is mounted on ball bearings and controlled either by hand or foot lever. The clutch facings have been changed from woven facings to bi-metal.

In the limelight

★ MONSANTO CHEMICAL CO., PLASTICS DIVISION, officially opened a large new plant at Springfield, Mass., April 29, for the production of Resinox plastic molding materials, widely used in the replacement of strategic metals needed in the defense program. The opening of the new facilities is said to make the Monsanto operation at Springfield the largest single plant for the production of plastic raw materials in the country. In addition to Resinox, six other major plastics are being produced. The added capacity is particularly significant in view of recent developments in the defense program.

Essentially two main operations are carried out in the new plant. One is the reacting of phenol and formaldehyde in large steam jacketed vacuum kettles with catalysts. From this reaction liquid resin is poured to cool and harden. Rolls, grinders, mixers and blenders where fillers, coloring matter and other ingredients are worked in, convert the resin into molding compounds which are supplied to plastic molders who fabricate them into finished articles and parts for thousands of different uses.

C. S. SHOEMAKER

S. W. PUTNAM

★ DOW CHEMICAL CO., MIDLAND, MICH., RECENTLY named Sherman W. Putnam, special products sales head, to the position of assistant general sales manager, and Clayton S. Shoemaker as manager of the Plastic Sales Division. In September 1919, Mr. Putnam became associated with Dow and has been, for the past 22 years, concerned with the sales development of new products. Mr. Shoemaker, formerly Cellulose Products Division manager, has been a member of the company's sales personnel since March 1937.

★ JAMES B. MILNE, FORMERLY APPLICATION ENGINEER in the commercial section of General Electric Co., Plastics Dept., Pittsfield, has been placed in charge of engineering and manufacturing. Mr. Milne has been with the company for 29 years and has participated in the 3 phases of the organization's business, manufacturing and sales.

★ ROY L. PEAT, PRESIDENT OF THE PLASTIC AND Die Cast Products Corp., was elected president and general manager of the organization at a recent meeting of the directors.

F. O. Eichelberger, Dayton City Manager, receiving souvenir of America's Modern Plastics Exposition from Mrs. Sherwood Standish of The American Red Cross while Mr. Charles Reiling, vice president of Elder & Johnston Co. looks efficiently at the laboratory molding press

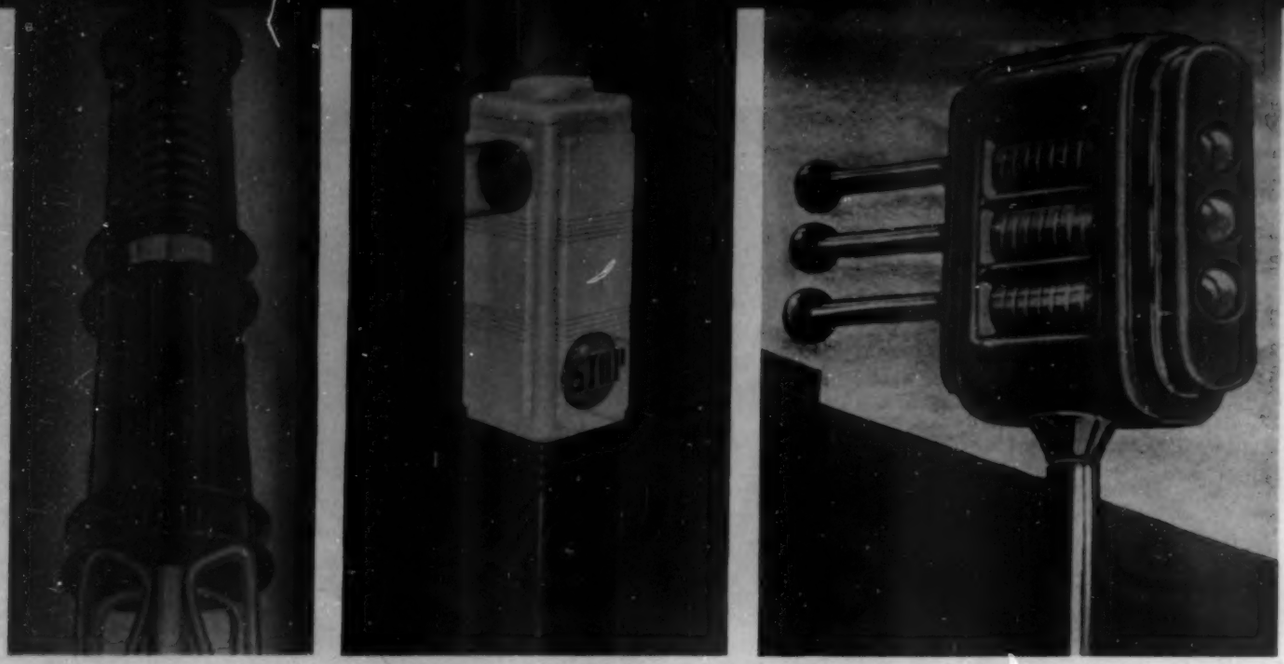
★ OVER 8500 VISITORS ATTENDED THE WORLD PREmiere of America's Modern Plastics Exposition at Elder and Johnston's department store, Dayton, Ohio, during the week of April 21–28th. Enthusiastically received by civic leaders, the press and public, the exhibition attracted crowds to see this remarkable educational display of plastics and plastic products (fully pictured and described in our May issue).

A special preview showing to which Dayton civic, educational and industrial leaders were invited was given at a luncheon sponsored by MODERN PLASTICS. Among those present were H. C. Berkeley, H. D. Geyer, Inland Mfg. Co., F. W. Berner, National Cash Register Co., Arthur E. Claggett, Supt. of Oakwood Schools, Dr. E. C. Waring, F. W. Gerard, Frigidaire Corp., Russ Matthews, Bakelite Corp., W. G. Davidson, C. H. Frantz, Kurz-Kasch, Inc., and members of Dayton newspapers, of the staffs of Elder & Johnston's and W. L. Stensgaard & Associates, Inc.

Dayton newspapers contained daily feature stories on interesting highlights of the show, including the Prize Essay Contest, the laboratory molding press demonstration molding souvenirs for the Red Cross, and the sound and color movie on plastics. In conjunction with its 58th Anniversary sale, Elder and Johnston's presented daily radio programs emphasizing the Exposition of plastics, had elaborate displays throughout the store, issued direct mail tabloids, as well as carrying on extensive newspaper advertising. Department store officials report that the Exposition was successful and worth while. F. O. Eichelberger, Dayton City Manager, and prominent local industrialists, have given high praise to the show.

A second showing of the Exposition at the Joseph Horne Co., Pittsburgh, Pa., June 2–7th, featured the "Largest American Flag in Plastics, Autos of 1950, and Plastics in Packaging." New features will be added as America's Modern Plastics Exposition makes its rounds throughout the country. Don't miss the showing in your locality!

(*Please turn to next page*)



Winners in the C. I. D. Traffic Control Light Competition make use of plastics for color, light transmission and durability. Left to right are 1st and 2nd awards and an Honorable Mention

★ PLASTICS PLAYED AN IMPORTANT PART IN THE Traffic Control Light Contest conducted by the Chicago Society of Industrial Designers recently in which 62 designers, draftsmen and students competed for the best designed "Traffic Control Light," such as is used at major intersections of Chicago streets.

Sarah Taylor Leavitt of Chicago, Ill., was first prize winner. She received $100 and a gold plaque from M. Rosenfeld, president of the Equitable Paper Bag Co. Second and third prize winners were, respectively, Theodore H. Koeber, Ft. Wayne, Ind., and Gilbert Gettleman, Milwaukee, Wis. There were ten honorable mentions. Judgment was passed on originality, practicality, structure and presentation by a board of distinguished judges. Second prize was $50.00 and a silver plaque and third prize, $25.00 and a bronze plaque.

Lucite was used by Miss Taylor for the lighted sections of her Traffic Control Light design (above at left). It was so used that light was permitted to emerge only from the end section. Each light, moreover, has a different design which makes it easy for people who are color blind to distinguish the light and to prevent confusion with surrounding lights.

Second prize winner, Theodore H. Koeber, used opalescent plastic panels with methyl methacrylate inserts for the words "Stop," and "Go" in his traffic light design (above center). The panels prevent sunlight from illuminating the light reflection but still allow the red, green and amber lights to show through.

Plastics attracted another competitor, Alex Tremulis of Chicago, Ill., who won honorable mention from the judges for his design on the traffic control light. Tremulis used Lumarith tubes through which the flashing light could be seen (above right).

In order to encourage as much ingenuity as possible in the competition, restrictions placed on the designers were kept at a minimum. They were, briefly a traffic control light that permits stop, go and intermediate warning signals; of a size and character that could be easily seen by motorists on the streets and pedestrians at intersections; of a character to be used in the center of a street, or at corners near the intersections of the sidewalks; designed for manufacture of materials which would produce reasonable economy of manufacture and reasonable maintenance over a period of usage, and of a design to improve the appearance of Chicago streets.

The jury was composed of Miss Anne Swainson, Director of Design for Montgomery Ward; Mr. Meyrick Rogers, Curator of Industrial Arts, Chicago Art Institute; Mr. Otto Jellinek, Chief of the Traffic Department, Chicago Park District; L. Moholy-Nagy, Director, School of Design, Chicago and Mr. A. Iannelli, selected for the C.I.S.D. from their membership.

★ JACQUE A. SALZ HAS BEEN ELECTED PRESIDENT of Salz Brothers, Inc., 1775 Broadway, New York City, manufacturer of fountain pens and pencils. I. Salz is now chairman of the board.

★ THE SEMI-ANNUAL MEETING OF THE AMERICAN Society of Mechanical Engineers will be held from June 16th to June 19th, inclusive, at the Hotel Muehlebach, Kansas City. Addresses will be made by authorities in their respective fields in both morning and afternoon sessions. Talks will be given in Education and Training, Fuels, Petroleum, Process Industries, Power, Railroads and Management.

D. E. A. CHARLTON

★ WE REGRET TO REPORT THE DEATH OF OUR former associate, D. E. A. ("Ted") Charlton, on April 29 at the Weston Sanitarium, Weston, Ontario. Mr. Charlton along with C. A. Breskin, founded Modern Packaging magazine in 1927. In 1938 he organized the Charlton Wrigley Corp., Toronto, to publish the Canadian business paper, *Moving Merchandise*, another step in an eventful career. *(Please turn to page 104)*

Process anneals of mold steels

(*Continued from page 65*) same areas after 1200 deg. F. anneal; on the crescent, about 3 points softer; and outside, somewhat softer than with the 1200 deg. F. anneal, but not as soft as the matrix. This comparison shows that at the lower temperature most of the strains are relieved and only a few additional lighter strains are taken out at 1500 deg. F.

Fig. 4 represents a block which was hobbed three times and annealed at 1500 deg. F. for two hours after each of the first two hobbings. After the third hobbing the block was cut in two; the left-hand piece receiving a third annealing at 1500 deg. F., the right-hand piece an anneal for two hours at 1695 deg. F. The development of large grain areas with the 1500 deg. F. anneal contrasts to the freedom from such areas after the anneal above the critical temperature. The Rockwell hardness of the piece annealed at 1695 deg. F. is 4 G Scale throughout, the same as the hardness of the block before hobbing.

The locations of the large grain critically strained areas within the piece are dependent upon the pressure used in hobbing. Fig. 5 is of a block hobbed at 100, 50 and 10 tons per square inch. An attempt was made to bring the grain growth to the surface. An anneal at 1200 deg. F. for 2 hours has developed the grain growth under the 10-ton impression showing that the large grains nearly embrace the cavity. In commercial die production occasionally a final light hobbing to bring up detail or produce exact size is performed. When any light pressure is used, the anneal under 1695 deg. F. is likely to develop large grains actually on the surface of the impression.

Employing low temperature anneals, in fact any temperature under the Ac_3 critical point, which is in the neighborhood of 1695 deg. F., develops grain growth within the piece or on the surface depending on the pressure. A large grain area on or under the surface of a finished die is probably undesirable. The area is soft by Rockwell exploration. A large single crystal of iron has about one-half the tensile strength of finely crystalline iron (Edward and Pfeil). It is reasonable to assume then, that in the compression a die experiences in service, a large grain deforms more readily than finely crystalline iron, and sinking of the bottom of the cavity may develop. Only a temperature in excess of the Ac_3 critical point will obliterate this large grain structure. There is an opportunity to use this high temperature during the carburizing process which, if conducted at 1695 deg. F., will not only be very effective for carburizing purposes, but will eliminate pre-existing grain enlargement.

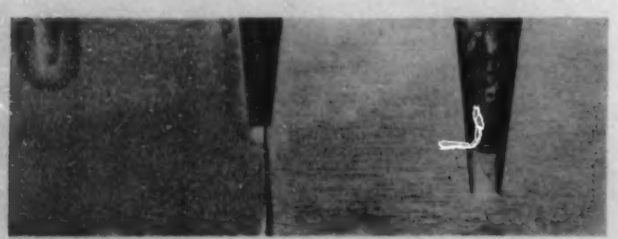


Fig. 4

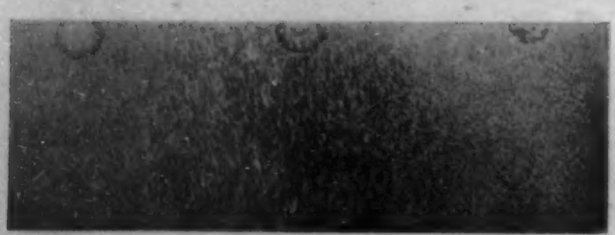


Fig. 5

Table 3 shows the average depth hobbed at each pressure after process annealing at the specified temperature for the three different lengths of times shown in Table 1. Each depth is the average of six hobbings for each pressure and temperature.

Table 4 represents the volume in cubic inches displaced by the average hobbing indicated in Table 3.

(*Please turn to next page*)

Table 3. Effect of Annealing Temperature on Average Depth of Subsequent Hobbings

Hobbing Pressure, Tons/Sq. In.	Depth Hobbed after Annealing at a Temperature of: 1100° F., In.	1200° F., In.	1300° F., In.	1400° F., In.	1500° F., In.	1695° F., In.
200	0.064	0.113	0.115	0.117	0.123	0.134
300	0.173	0.242	0.246	0.252	0.298	0.330
400	0.286	0.408	0.412	0.425	0.496	0.553

Table 4. Effect of Annealing Temperature on Average Volume Displaced in Subsequent Hobbings

Hobbing Pressure, Tons/Sq. In.	Volume Displacement by Hobbing after Annealing at a Temperature of: 1100° F., Cu. In.	1200° F., Cu. In.	1300° F., Cu. In.	1400° F., Cu. In.	1500° F., Cu. In.	1695° F., Cu. In.
200	0.00332	0.00610	0.00621	0.00634	0.00674	0.00735
300	0.00981	0.01423	0.01480	0.01528	0.01870	0.02130
400	0.01728	0.02790	0.02825	0.02973	0.03620	0.04200

Table 5. Effect of Annealing Temperature on Hobbing Quality (Anneal at 1695° F. = 100%)

Hobbing Pressure, Tons/Sq. In.	Hobbing Quality after Annealing at a Temperature of: 1100° F., Per-cent	1200° F., Per-cent	1300° F., Per-cent	1400° F., Per-cent	1500° F., Per-cent	1695° F., Per-cent
200	45	83	84	86	92	100
300	46	67	69	72	88	100
400	41	66	67	71	86	100
Average percentage	44	72	74	76	89	100

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SEMS Fastener Units...Lock Washers . . . Locking and Plain Terminals
Thread-Cutting Screws . . . Locking Screws . . . Spring Washers Special Stampings

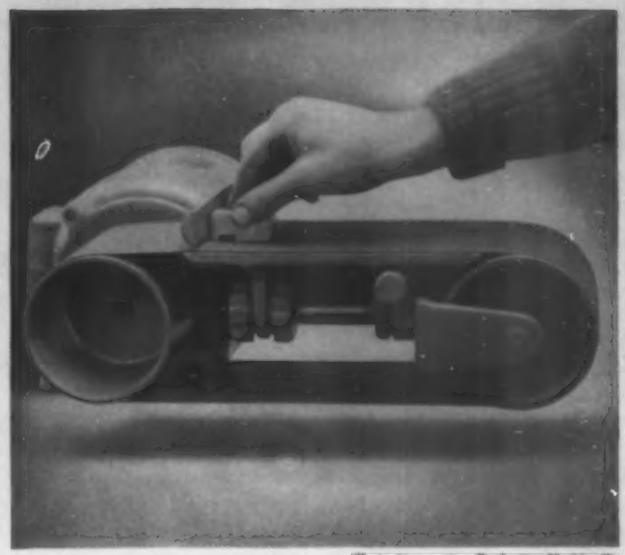

Illustration courtesy Production Machine Co.

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Coated Abrasives
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QUALITY ABRASIVES SINCE 1903

In Table 5 the percentage of hobbing quality imparted by the various anneals is given, using the anneal at 1695 deg. F. as 100 percent. The average of the percentage of hobbing from 1200 deg. F. anneals, compared to 1695 deg. F. anneals, is about 72 percent; and as compared to 1500 deg. F. anneals, about 81 percent.

In conclusion, the results of these tests would indicate the advisability of adopting:

1—Process anneals at 1200 to 1250 deg. F. for short times.

2—Carburizing temperatures above the upper critical temperature or about 1695 deg. F.

The advantages of the first conclusion would include elimination of packing for long time anneals and the possibility of using salt baths or neutral atmospheres. Short times at temperature can be used and cooling can be rapid either in air or by quenching. We believe in many cases these advantages will materially reduce the time required to produce dies.

The higher carburizing heat, by eliminating coarse grain material below the surface of the impression, should serve to increase core strength and prevent sinking. Better penetration of carbon will also be assured by the higher carburizing temperature.

Acrylics in aircraft

(*Continued from page 45*) good technique to apply comparatively light pressure to eliminate "grabbing" when the drill penetrates the piece. After the sheet is trimmed to the smoothly rounded curves demanded, it is then polished with cloths and power buffs to a clean finish (Fig. 6).

In all machining and buffing operations, it should be remembered that acrylate sheet softens at higher temperatures and may gum up the tools if heat is allowed to build up at any point.

It is impossible to lay down rigid rules for mounting plastics. This is dictated by the size, shape and service required of any given section. In general, however, flat sections and sections curved to less than a 45 deg. arc can be installed in channels without bolting.

The availability of the acrylic sheets in sizes up to 45 in. by 65 in. gives the aircraft engineer latitude in the design of transparent sections. The acrylic is also available in thicknesses up to $2^1/_2$ in., but for most aircraft purposes, .250 in. or thinner material has proved satisfactory. For low speed aircraft and gliders, material as thin as .060 in. to .100 in. can be used. Sections in high speed aircraft are usually .125 in. to .150 in. in thickness when they are less than 1 sq. ft. in area, but landing light covers are usually made of thicker material to allow for a routed edge. Larger areas, especially those of a span of more than 2 ft., should be made of .200 in. to .250 in. material.

Acrylic sections are subject to internal pressure because of the airflow over their surface. This must determine the proper sheet thickness and type of mounting selected. Unless material of sufficient rigidity is used and properly secured in place, it may be sucked out of its channel when the plane flies at high speeds.

Once in position, the plastic sections are firm and durable and neither Libian heat nor Narvik cold will make them discolor or warp. While not bullet-proof, they will not shatter. The weight saved by the use of plastic is vital, for airspeeds depend largely on weight and every pound saved adds another incendiary bomb.

In addition to aircraft, the material is being widely used for windows and gun-turrets in torpedo boats.

Credits: Plexiglas used in Martin B-26 bomber.

A. R. P. apparel

(*Continued from page 53*) dress. It can serve as a market bag when pulled with a string, or zipper, and can also be used as a blanket or a covering for a child.

The laminated helmet weighs only $1^3/_4$ lbs., as against $5^1/_4$ lbs. of corresponding metal headgear. The following rigid tests were made on the helmet: An 8-lb. solid iron ball, 3.8-in. diameter was dropped from a height of 4 ft. on the helmet without denting it; a $^1/_2$-lb. ball was dropped from progressive heights up to 50 ft. 38 times without denting the crown.

A blackout safety signal light is almost a "must" with the air raid costumes. The plastic flashlight switches on and off in a jiffy. For blackouts, it is made in blue, to throw a very faint glow, invisible from the sky. Developed simultaneously with the costumes, the flashlight can be used also for civilian purposes, and is made in other styles which give a bright, four-directional light. It is an injection molded, hollow tube approximately 6 in. long and consists of 3 plastic parts, easily assembled. The manufacturer has taken advantage of the unique properties of methyl methacrylate which allows the light to travel in all directions. The battery fits inside the tube. Threads are molded right into the top of the flashlight and a pushbutton cap screws over it. A slight twist of the top releases a full glow, similar to a neon light and visible through the entire length of the tube. Cases are red, blue, or transparent.

The light may be carried as a swinging lantern by means of a metal ring at the top. A molded plastic top, of cellulose acetate, fits over one end, so that the light may stand vertically as a marker for dangerous excavations, to mark stalled cars at night, or to serve as a night lamp.

As a further protection against danger to the vital organs by bomb concussion, a rubber jacket is worn under the costume. With the "plastic armor" it is believed that people under stress may feel, even in small degree, there is some measure of protection against injury to life and limb—at least enough to enable them to "keep on taking it."

Credits: Plastics materials by E. I. du Pont de Nemours Co., Inc. Manufacturer: Gemloid Corp. Gemglo Flashlight and Plastic Armor (patents and trademarks pending) designed by J. Frank, and by Dr. S. L. Ruskin and J. Frank, respectively. Costumes designed by Sadie Nemser and Frances Ruskin.

CLASSIFIED

➡ WANTED: Injection Molding Acetate Scrap or Rejects in any form, including Styrene, Acrylic, Vinyl Resin Scrap materials. Submit samples and details of quantities, grades and colors for our quotation. Reply Plastics, 141 Halsey St., Newark, N. J.

➡ PLASTIC MOLD & DIE BUSINESS FOR SALE: Capacity fifty mold and die makers. New shop and equipment. Extra land available for more than doubling plant capacity. Business established 9 years. Has excellent earning record during entire 9 years. Enviable reputation in the trade. Sale price $110,000. Please write for further details to Ralph K. Panzer, Penobscot Bldg., Detroit, Mich.

➡ WANTED: Stainless Steel or Nickel Kettle, Vacuum Pan, Hydraulic Press, Preform Machine and Mixer. Reply Box 275, Modern Plastics. No Dealers.

➡ WANTED: PLASTICS SCRAP OR REJECTS in any form, Cellulose Acetate, Butyrate, Polystyrene, Acrylic, Vinyl Resin, etc. Also wanted surplus lots of phenolic and urea molding materials. Reply Box 318, Modern Plastics.

➡ 2 OZ. H-P-M INJECTION MOLDING MACHINE FOR SALE—Model #54, in excellent condition. Address Box 433, Modern Plastics.

➡ FOR SALE: 2—84″ Mixing Rolls; 10—Semi-Auto Presses, 75 to 400 tons, ejectors and pull backs; 4—Grould Triplex Hydraulic Pumps, 2—1500 PSI, 35 GPM, 2—3000 PSI, 18 GPM; 12—30″ x 40″ PLATEN, 500 ton Hydraulic Press, 1—W.S. 15 x 18″ Hyd. Press, 9″ dia. ram, 4—″ posts; 1—W. S. 24 x 48″ Hyd. Press, 12″ dia. ram, with hyd. pushbacks; 1—46″ x 54″ Hyd. Press, 19″ dia. ram; 1—Thropp 36″ x 36″ 4-opening Hyd. Press, 12″ dia. ram; 2—Bethlehem 38″ x 78″ Hyd. Presses, with 20″ dia. rams; 1—Farrell two-cylinder vertical Hyd. Extrusion Press and Pump; Birm. 16 x 36 Mixing Rolls, silent chain 40 HP drive; 2—Farrell 60″ Mixing Rolls, 4″ Extruder; 7—W. & P. Mixers. 1—50 gal. Nickel Vac. Pan. Send for Complete List. Reply Box 446. Modern Plastics.

➡ FOR SALE: 1—Worthington Air Compressor, Type VA-2-SD-750, Size 6 1/2″ x 3 1/2 x 4″, 150 lb. Pressure, 2-Stage Complete with Motor and Tank. 1—Curtis #85 Air Compressor, 100 lb. Pressure, Complete with Tank. Reply Box 435, Modern Plastics.

➡ FOR IMMEDIATE SALE: Semi-Automatic Hydraulic Presses, 2—125 Ton, 13″ Ram, 23″ x 17″ platens, 2000 lbs. per sq. in. 1—400 Ton Horiz. Hydraulic Extrusion Press. 1—Hydraulic Scrap Baler, 80 Ton, 6 1/2″ Ram, 90″ stroke, 5000 lbs. per sq. in. Large stocks Hydraulic Presses, Pumps & Accumulators, Preform Machines, Rotary Cutters, Mixers, Grinders, Pulverizers, Tumbling Barrels, Drill Presses, Lathes, Gas Boilers, etc. Send for Bulletins #156 and #128, and L-17. We also buy your surplus machinery for cash. Reply Box 439, Modern Plastics.

➡ EXECUTIVE WILL INVEST $5,000.00 (eventually more) in established molding concern. Active participation only. Location secondary. Box 443, Modern Plastics.

➡ POSITION WANTED: Thoroughly familiar with development sales, technical sales, of molding, casting, lamination, grinding wheel, brake lining paint & varnish and specialty resins of phenolic type. Would be willing to enter another field connected with resins. 21 years' experience anxious to locate with company to show my ability. Reply Box 444, Modern Plastics.

➡ CAPITAL TO INVEST—Aggressive young man, college graduate (37 years old) has $25,000 to purchase active interest in established molding plant, where his services can be utilized. An excellent opportunity to get a real go-getter. Reply Box 445, Modern Plastics.

➡ WE ARE SEEKING an experienced man in the injection molding field. Must have thorough knowledge of Reed-Prentice machines, molding technique and molding powders. Excellent opportunity for right man. Good salary. Advance Molding Corp., 54 W. 21st St., New York, N. Y.

➡ CHEMICAL ENGINEER experienced in thermoplastic and thermosetting molding materials, thermoplastic resins—poly-iso butylene, polystyrene, vinylite, ethyl cellulose, nitro cellulose etc. Experience diversified in research, production, technical sales. Age 38. Open for new connection. Reply Box 447.

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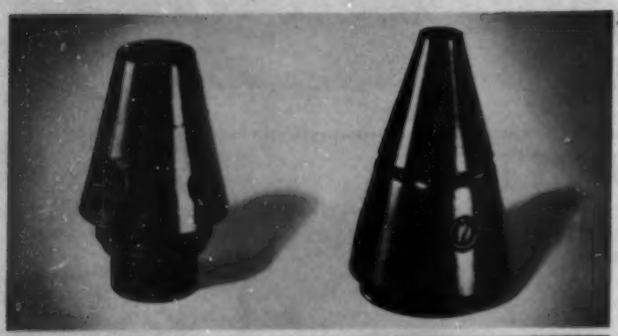

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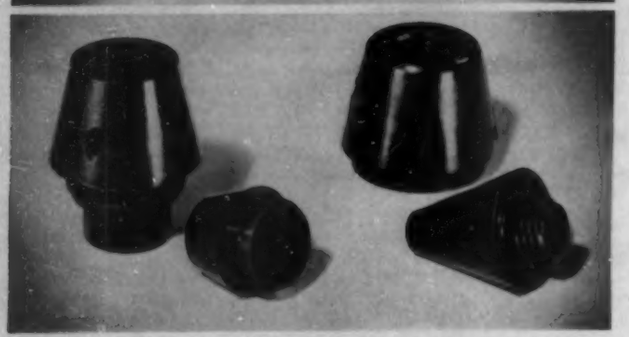


A group of thermosetting plastic Army Ordnance parts now in the development stage are pictured above. **1**—Three munitions ogives (or windshields for shells) in various sizes. Left to right: 75 mm., 37 mm., 57 mm. At extreme right is a fuze well cup. **2**—Two experimental transfer molded bomb fins with long and short shaft. **3**—Left: fuze detonator assembled with separate parts pictured directly below. Right: time fuze detonator assembled with individual parts immediately below. Both are transfer-molded

SPI meets at Hot Springs

(*Continued from page 56*) developed than the breaking up of TNT. I will not attempt to explain whose fault this was, but I will say that those in higher authority have very properly questioned plastics in ammunition unless they can be assured that similar occurrences will not happen in the future.

"The 60-mm. Mortar ammunition is a small type of shell approximately 2½ in. in diameter with a supersensitive fuze and a fin attached to the rear end for stabilization. The fin consists of a central tube which must withstand the firings of a shot gun cartridge loaded with smokeless powder and to which are attached fins, sufficiently strong to stay true and straight during firing. These fins, in the past, have been spot welded to the central core, which is a reasonably slow operation.

"One of the first proposals made by representatives of the plastic industry to the Ordnance Department was that they be given an opportunity to demonstrate that this element could be produced in plastics. A small contract was let, and after repeated trials it can be said that the results have been completely negative. We still have hopes that a steel central core to which plastic fins have been molded by insert molding may be feasible.

"The 81-mm. Mortar ammunition, about 3½ in. in diameter, has a very similar form of fin, except that on certain types the powder increments for the several zones are located forward of the fin and not within the fin. This lends itself more readily to a process comparable to die casting or plastic casting, and it is hoped that wihin a very few weeks we will be in a position to say whether or not the problem can be solved, as two very representative manufacturers are actively engaged on small contracts for this development.

One of the first choke points to develop in our present munition program was caused by the lack of screw machines to be used in the manufacture of fuzes above one inch in diameter. On to this choke point there has been superimposed, within the past few months, a scarcity of aluminum bar stock. Anticipating these conditions, the Ordnance Department undertook the development, through plastic producers and molders, of the three principle bodies of our M52 Fuze, which is the fuze used in both the 60-mm. and 81-mm. Mortars, and which at a time of maximum military effort, would be needed in great quantities. Many kinds of plastics, mostly of the thermoplastic type, have been presented during the past year to solve this problem, but to date it has not been solved, although it is not considered impossible.

A fuze is a reasonably complicated item. It must be accurate, simple and safe, as well as having a reliability of the order of 99 percent. Into the fuze bodies are assembled metal components of different substances, such as brass, and steel, but they also contain small quantities of the chemical material, such as lead azide, tetryl, fulminate of mercury, and similar ingredients.

The sun conditions in North Africa today are probably giving temperatures of 150 deg. Fahrenheit; the temperature in the holds of our ammunition boats going to the Panama Canal sometimes reaches 170 deg. This same temperature is probably reached in certain types of storage within the continental limits of the United States near the Mexican border. As all of you can remember the conditions under which the Finns were required to fight some fifteen months ago. 50 deg. below zero is not a temperature which cannot be expected in the interior of Alaska and other parts of the Northern Hemisphere.

You can therefore appreciate that any plastic to be used in a fuze must not only not be affected by these temperatures momentarily, but repeated reversals in storage must have little or no effect. To date, no thermoplastic material has been presented which meets these conditions and at the same time has so low a cold flow as to make the material acceptable after a few months of storage. While the Ordnance Department does not believe that it should condemn thermoplastic materials as a group, nothing has been presented to date which should make us believe that they possess the physical properties to justify their adaptation for components of ammunition. (*Please turn to next page*)

National defense was the keynote of formal discussions at the SPI Spring meeting but members found time to enjoy fine golfing weather between business sessions

Every anti-aircraft shell above 1½ in. in diameter must be equipped with a fuze which would make the shell explode at a pre-determined point in space with an accuracy sufficiently great to justify the expenditure of the ammunition against the moving target. There are two types of fuzes, namely, mechanical and powder train. Under fixed conditions, a powder train fuze is as accurate as the mechanical, but unfortunately its time of burning is greatly influenced by altitude and barometric conditions. Therefore, the anti-aircraft artillery of the world is rapidly adopting the mechanical type of fuze. Now this fuze, reduced to its simplest form, is a watch, or clock mechanism and possesses all the inherent mechanical contrivances connected therewith.

It is interesting to note exactly what this watch has to do when attached to the front end of a shell. In order to bring about stability in flight, the shell must be rotated, and in a 3-in. gun this rotation may amount to as high as 25,000 revolutions per minute. It is accelerated by the powder charge so that every grain, or 1/7000 of a pound, has a set back force of approximately 3 pounds. The reaction due to the powder case on the base of the shell is the equivalent of dropping the shell base down on a piece of armor plate from a height of 50 feet. Our fuzes are actually tested in this manner and retain their accuracy. All of you have watches that cost many times more than we are paying today for complete fuzes, and you can appreciate what has been done in the development of a mechanical fuze if you will merely subject your watch to this same test.

One of the early ideas for the use of plastics was to cast the body of the fuze for this element of ordnance. It was not a success, but the plastics industry need not feel chagrined because this body not only has to stand the strains previously specified, but it also must not warp so that the fuze clock mechanism will not be distorted or compressed. The requirements for acceptance of the fuzes now being produced are that the mean variation in time shall not be greater than ½ of 1 percent, and our fuzes are actually bettering this requirement both in commercial and Government arsenal manufacture. In fact, many lots show a mean variation of not more than ¼ of 1 percent.

Another portion of the fuze for which plastics have been considered can be called the "body of the impact fuze." It is rather thin walled. It also has to stand high set back and rotational forces. The tests have shown that these have nearly been met and there is reason to believe that they can be satisfactorily produced. This development has not been pushed because of the fact that it is not a screw machine job and therefore does not have as high a priority as some of the others.

The 20-mm. aircraft gun is one that has proven its value in the present European War and is being adopted as a standard in the American Army. It is a full automatic weapon and the loading and feed mechanisms are dependent upon their satisfactory operation by the shape of the forward end of the projectile as well as by other characteristics.

The high explosive shell has a comparatively light wall with the nose type of fuze. The practice or standard type of ammunition is a piece of bar stock machined with relatively soft steel and of the same shape and weight as the high explosive. The third type of ammunition is the armor piercing, which to be effective must be solid and, as it must have the same weight as the other two types in order that the trajectory will be the same, it necessarily follows that the shape will be different. We have overcome this by placing on the nose of the armor piercing projectile a simple screw of brass and attaching to the shell a plastic cap which makes all three units the same external shape

and, as they have the same weight, it follows that their striking point for a given laying of the gun will be the same.

While it would be preferable to have this plastic cap remain on the armor piercing shell through its entire trajectory, the Ordnance Department will be satisfied if it does not break up in the loading operation and if it passes through the bore of the gun. Remember that in a travel of approximately four feet this shell must be accelerated from zero to 2800 ft per sec. and must have a spin imparted to it of more than 100,000 revolutions per minute. It is not believed that any commercial use of plastics is called upon to meet conditions.

Another instance in which we are attempting to use plastics is the false windshield of the 37-mm. armor piercing projectile. This was originally made from aluminum bar stock. Due to the strategic position that this material is assuming, as well as the greatly accelerated demand for other purposes, it is felt that the plastic windshield could be made if properly reinforced and ribbed. We have reason to believe that the windshield will stand the firing strains, but there is some question as to whether or not in the banging which a round of ammunition receives under the adverse conditions of rapid fire, particularly with a weapon used for short range work, the side blows may break the shell off before the round is loaded. In very elementary and preliminary tests these feelings have been borne out, and yet is is believed that by suitable reinforcing, and possibly by the thickening up of certain sections, trouble can be overcome.

The last item that I wish to call to your attention is the fuze for a bomb. This is placed in the nose of the bomb and is required to function even though the bomb strikes materials as hard as reinforced concrete or as soft as certain types of steel. The fuze can be set for either instantaneous or delay action, the delay being one-tenth of a second. It therefore follows that for this time event to take place the portion of the fuze containing that element must not be destroyed.

The only portion of this fuze that it is believed would lend itself at all to the use of plastics is the body, which is within the bomb and therefore reasonably well protected. It is rather complicated in its design and requires much machine work. Therefore, production could be accelerated if plastics could be made to meet the physical needs. While, of course, it is never intended to assume that a saving of money is not desirable and justifiable, I believe you will appreciate that no saving of money on a fuze to be used under bombing conditions is justifiable if the reliability of the fuze is in any way adversely affected, no matter how small the amount.

A larger modern bomber can be assumed to cost in the neighborhood of a quarter of a million dollars. The value of its crew to the nation plus the cost of the training of this crew would probably be nearly as much. The bombs themselves represent an appreciable investment. Now if a bomb, when carried a thousand miles more or less by a machine which represents an investment of this magnitude, fails to explode, the entire mission can be written off as a complete loss, and if this failure originated because of the malfunction of the fuze, you can see that a few pennies saved on that item would certainly come under the heading of "penny wise and pound foolish."

James A. Lee, Managing Editor of *Chemical & Metallurgical Engineering*, discussed at length the raw materials situation and production facilities for chemicals required in the plastics industry. His survey indicates that several of the raw materials required are every bit as vital to the defense program as the metals for which it has been suggested the plastic products be substituted. Sufficiently large supplies of some chemicals will be available to take care of the greater needs but others are in a more uncertain position. Excerpts from Mr. Lee's talk follow:

"With the scarcity of some of the metals and the recommendation that plastics be substituted where possible, earlier estimates for 1941 requirements of phenol have been revised upwards. While military requirements will fall far below those of 1918, they may account for about 15,000,000 lbs., and estimating other requirements at 50,000,000 lbs. for synthetic resins, 15,000,000 lbs. for chemicals, 10,000,000 lbs. for oil refining, and 5,000,000 lbs. for exports, a grand total of 95,000,000 lbs. is indicated. Judging from the status of the present market, demand is running ahead of supply and productive activities must be expanded if all needs are to be met. But this may not be a difficult task."

Formaldehyde

"Figures for domestic production of formaldehyde were reported by the U. S. Tariff Commission for 1933 and prior years but no data were given for the 1934–1938 period. With the exception of 1927, the output increased steadily each year from 1922 through 1929, production for the latter year amounting to 51,786,000 lbs. In 1933 production was reported at 52,236,000 lbs. From that year up to 1939 no comparable data are available but it is known that production was on an increasing scale and the total for 1939 was given as 134,479,000 lbs. which undoubtedly was a record for the industry. In addition to its use in resin manufacture, formaldehyde finds important outlets in indigo manufacture, in making sodium sulphoxalate formaldehyde, as a disinfectant, deodorant, and preservative, as fungicide, in embalming fluids, in tanning, and in making wall paper and coated paper. In recent years there has been a rising call for formaldehyde in the export trade with more than 5,700,000 lbs. shipped abroad in 1940 and with monthly shipments so far this year being in excess of the 1940 rate.

"The rapid rise in production of formaldehyde has been due to the increase in output of resins. As formaldehyde is made from methanol, it follows that its production is limited not only by existing plant capacities but also by the amount of available methanol. At present there are four domestic producers of formaldehyde, two of which produce methanol.

"Domestic production of methanol has been more than doubled in the last six years with the increase being entirely in the synthetic product. While production of formaldehyde also has more than doubled in the same period, this alone would not account for the sharp rise in methanol output. The largest distribution of methanol is in the anti-freeze trade. Last year formaldehyde accounted for about 20 percent of the methanol supply. Synthetic methanol, which accounts for about 90 percent of total domestic supply, is made by four companies.

"With the abnormal demand for nitric acid which lies ahead, unusually large amounts of ammonia must be made available and already some of the methanol capacity has been turned over to ammonia production. Production data for February this year showed a drop of more than 600,000 gal. for methanol as compared with the corresponding month of last year. Difficulties in securing some of the equipment necessary for new ammonia plants is causing delays in placing these plants in operation. Should a greater part of methanol capacity be switched over to ammonia, the supply available for formaldehyde and other uses will not be sufficient. Scarcity of both formaldehyde and methanol already has been reported in domestic markets. Application of control or allotment of shipments would work a hardship on producers if the anti-freeze market should be curtailed since the position methanol has attained resulted from long and costly sales programs which have given prominent to special brands.

METHANOL PRODUCTION

Year	Synthetic 1000 gal.	Crude 1000 gal.
1940	44,968	5,294
1939	34,256	4,660
1938	26,031	4,170
1937	31,814	5,754
1936	25,563	5,575
1935	18,047	5,049
1934	12,534	4,122

(*Please turn to next page*)

Urea *(Continued from preceding page)*

"Urea resins are often associated with phenolics as both groups have a raw material, formaldehyde, in common. Production of urea resins averaged less than 4,000,000 lbs. in 1933–1935, but since then have gained steadily in importance and in 1939, 16,569,343 lbs. were produced with eight companies in the field. And at the present time two large plants are nearing completion, which will greatly increase the manufacturing capacity of the industry.

"Production of urea in this country is confined to one company and figures for the output are not available. Prior to 1935, requirements for crystal urea were met by importations but from that time on, domestic material has been prominent and arrivals from abroad have been consistently declining. Imports reached their peak in 1930 when they exceed 20,000,000 lbs. By 1937 they had dropped to a little more than 5,000,000 lbs., and as Germany was the principal supplier, it has been difficult to secure foreign material since the outbreak of hostilities and imports in 1939 fell to 1,464,000 lbs. with no arrivals reported in 1940. Hence the question of urea supplies is now a domestic problem. Ammonia is one of the essential raw materials required for urea production and the uncertainty surrounding future ammonia supplies is equally applicable to urea.

"What has been previously stated regarding the effect of the defense program upon the availability of formaldehyde for use in making phenolic resins holds true for the urea resin field as well."

Acetic acid and anhydride

"Cellulose acetate producers appear to be in a comparatively secure position regarding the chemical raw materials, acetic acid and acetic anhydride. Plant capacities for acetic acid were considerably expanded in 1939 and 1940 and apparently can be further increased should the necessity arise. Considering the variations in process and raw materials used there is no indication that acid supplies will be limited despite the rapid gain in consuming requirements which has been noted in recent years. Prior to 1926 all domestic acetic acid production was from acetate of lime. At present in addition to the output of the hardwood distillation industry, synthetic acid is being made from acetylene, methanol, and ethyl alcohol. Possible shortages in some of these raw materials undoubtedly could be made up wholly or in large part by greater production from the materials available.

"The situation with regard to acetic anhydride so closely parallels that reported for the acid that the same conclusions will hold good for that product."

Cotton Linters

"The supply situation in cotton linters is much more disturbed than in chemical raw materials. The smokeless powder producers get the first call and the great plants of the government at Radford, Va., and Charlestown, Ind., are commencing to operate. When these plants reach their capacities they and the several smaller smokeless powder plants now operating will demand enormous quantities of cotton linters. A federal loan recently was granted one of the two linter purification companies so that the capacity of its plant might be increased. However, there is considerable question regarding the adequacy of the crop of raw linters. Should the crop prove to be too small to meet the requirements of the great smokeless powder plants, the industry will make up the difference from either the cotton now held in warehouses by the Federal Government or from wood pulp.

"After the smokeless powder requirements have been met, the cellulose plastic industry must compete with rayon and other consuming industries for linters."

Nitric acid

"Nitrocellulose depends upon linters and nitric acid. Because of its paramount importance in the munitions field, nitric acid must be considered as one of the key chemicals whose use in ordinary channels may be determined by the extent to which its finished products are classified as essential. Production of nitric acid, basis 100 percent, is estimated at 200,000 tons in 1940 and annual requirements with the defense program in operation are estimated at 1,000,000 tons. Under present procedure, practically all the nitric acid produced in this country comes from the oxidation of ammonia.

"In addition to new plants for ammonia, equipment now used in making methanol and synthetic nitrate of soda can be turned over to ammonia. There also is the probability that an additional acid supply may be found by utilizing the former method of making it from Chilean nitrate of soda. In the meantime the buying season in the fertilizer industry is passing and this will release some ammonia for other purposes. Later on the fertilizer and other industries may be called upon to seek other sources for their nitrogen requirements. Despite all these expedients, it is generally regarded that ammonia will be in a tight position for some time and as military quotas undoubtedly will be given preference, whatever amounts remain for general distribution may be allocated on a basis of industry importance.

"At the present time there is a scarcity of phthalic anhydride and there are rumors that large volumes are going into dibutyl phthalate for use in explosives. If this is the case the supply available to the synthetic resin industry will become smaller.

"Vinyl resins have been increasing in importance in recent years and this growth has been reflected in increasing demands for the raw materials, butaldehyde, vinyl acetate and vinyl chloride. The acetate is made from acetylene and acetic acid and the chloride from acetylene and hydrochloric acid.

"The supply of acetic acid has already been discussed. There should be no shortage of acetylene, which is produced from carbide, the electric furnace product of coke and lime. The supply of hydrochloric acid appears to be ample.

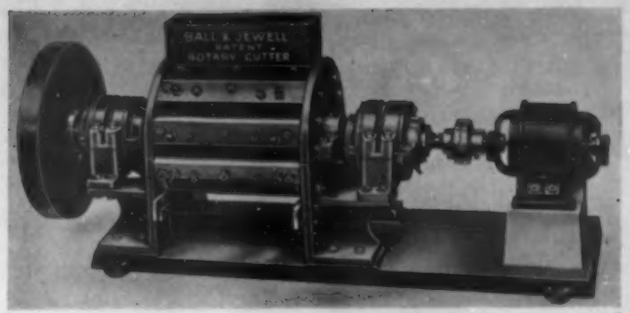
"Polystyrene is made from ethylene and benzene. The former comes from petroleum or natural gas and the latter from by-product coke ovens. There should be no shortage of these raw materials.

"Acrylic and methacrylic resins are made by polymerizing derivatives of acrylic acid. Raw materials are methanol, acetone, sulphuric acid, and hydrogen cyanide or sodium cyanide. Of these raw materials the only ones that may cause concern are methanol and acetone. As stated earlier, a very real shortage is expected to develop in methanol due to the necessity for using the methanol plants to produce ammonia for defense purposes. However, the producers of this type of resin should be able to obtain sufficient methanol for their requirements as it will be used to produce airplane windshields, cockpit enclosures and other parts for machines needed by our army and navy.

"One of the newest of the plastics to come on the market is vinylidene chloride, a resin said to be made from ethylene and chlorine. The ethylene is obtained from cracked petroleum gases or natural gas. There should be no shortage of these materials."

The Substitution of Plastics for Metal with particular reference to the automotive industry was discussed by N. J. Rakas, of the Rubber and Plastics Laboratory, Chrysler Corp. He pointed out that should present metal shortages become acute, it would be desirous to make immediate replacements where possible, so that strategic metals now on hand may be conserved for the parts not suitable for plastic reproduction.

"Up to the present day," Mr. Rakas said, "plastics have already enjoyed considerable use in the automotive field, particularly along the decorative and trim adaptations. Nickel and chromium plated zinc die cast parts have also fulfilled their share of similar applications. Therefore, we see no reason why plastics cannot be extended along this line to replace some of these metals. As an illustration, we have definitely released methyl methacrylate to replace zinc die cast radiator ornaments. Various inside and outside medallions, which heretofore were made from gilter metals, are being reproduced in plastic with painted backgrounds. Both of these reproductions in various



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colors of plastic, offer better appearance than do the plated zinc die cast parts which are comparatively lifeless. Tests and investigations in our Engineering Laboratory show that methyl methacrylate is more serviceable on outside uses than the zinc parts, from the standpoint of longer weather resistance. Finally, the plastic must be properly molded to withstand varying temperature changes and this depends a great deal upon the gating of the injection molding dies. We find it advisable to gate the die in such a manner so the piece will have minimum molding strains, since it is difficult to eliminate all of the inherent strains.

"All of the control knobs which were formerly zinc die cast are also being replaced with cellulose acetate or cellulose acetate butyrate plastics molded around steel inserts.

"The larger decorative and structural zinc parts will be made of steel stampings, because lack of sufficient time for tooling and building enough of the twelve-ounce injection molding presses will not permit replacements in plastic. However, some of the moderate sized metal parts, such as various housings, barrel locks, glove box doors and other parts, can easily be duplicated with little change in designs out of high strength thermosetting plastics and laminates. A number of such parts are under development and in due time will be released."

Administrations of priorities is not a simple matter and different situations require different methods of approach. Some of the problems connected with priorities and methods of dealing with conditions which involve requirements of the armed forces and the civilian population were discussed by Dr. D. P. Morgan, Director of Division of Priorities, O. P. M. He urged the plastics industries to keep in close touch with headquarters of that division to insure maximum cooperation. Important points of his speech follow:

In speaking of priorities the term is used in the broad sense which includes preference ratings, allocations, mandatory orders and the like.

"In putting its powers into effect, the Priorities Division has developed two phases of its system. The task of handling priorities in the strictly military sphere is given to the Army and Navy Munitions Board. The over-all supervision, administration of priorities in the non-military sphere is administered directly by the Priorities Division. These aspects of the program are described separately.

A. The Army and Navy munitions board

"In accordance with directions of the Army and Navy joint board, the Army and Navy Munitions Board and other appropriate agencies have been in charge of determining the relative importance, from the point of view of national defense, of all military items, such as airplanes, tanks, submarines, ammunition, shells, uniforms, machine guns, radios, steel lockers, gas masks, trucks, and all the other things the armed services must have. The job of deciding what the nation needs for defense is a military problem, decided by the military and naval experts.

"Now in putting all these aspects of the problem together in an intelligible pattern, the military and other defense agencies concerned use two very important instruments. One of these is the Priorities Critical List, an alphabetical listing of over 200 primary military items which are needed for defense and on orders for which priority certificates can be issued automatically, to speed up production, by contracting officers of Army and Navy. The other instrument, the official directive, fixes the order of importance of these items or categories of these items. It is by the directive that the broad objectives of the defense program; and the purpose for which material is needed, are correlated in such a way as to show orders for items on the Priorities Critical List can be given ratings.

"The assignment of ratings by the Army and Navy contracting officers is often called the 'automatic' phase. This means that the Army and Navy representatives may automatically issue ratings on prime contracts for items which appear on the critical list (the kind of rating being set by the directive), and may extend such ratings to a subcontractor or a sub-sub-subcontractor who is producing items on the list. So far as the automatic phase of the program is concerned, the Priorities Critical List is the control. If an item is on the list, either because it is specifically listed or because it is an especially designed part of some item that is listed, then it can be rated automatically by the Army and Navy Munitions Board and its agents in the field, if all other routine requirements are met.

B. The priorities division

"It can be seen at once that in addition to the strictly military sphere limited by the Priorities Critical List there are many other areas in which priority questions may and do arise. Such problems are administered directly by the Priorities Division.

"The Priorities Division of the Office of Production Management administers all requests for preference ratings on civilian contracts. It determines preference ratings for those items, including civilian items and military items, which do not appear on the critical list. It handles the allocation of all materials—for example, aluminum—which have been subjected to industry-wide priority control. Such industry-wide allocations modify and take precedence over any individual priority certificates which may have otherwise been issued against such materials.

"And any new, broad problems which may arise in either the field of policy or practice will involve a decision on the part of the Priorities Division, often in consultation with representatives of the Army and Navy to make sure that all aspects of the situation have been properly considered and integrated.

"In administering its phase of the system, the Priorities Division has available a number of instruments. The system is designed to be flexible, and it is more important to fit the treatment to the problem than to try to fit the problem into a rigid pattern of treatment. But it may be said that, in general, there are three broad steps that the Division can take to give priority aid. These are: (1) blanket ratings of a limited type, designed to help certain companies or projects in urgent situations to obtain needed materials quickly; (2) individual preference rating certificates, issued to manufacturers for specific orders, to meet specific problems; and (3) industry-wide priority control, usually involving the allocation of available supplies."

Phenol with cottonseed hulls

(*Continued from page 68*)

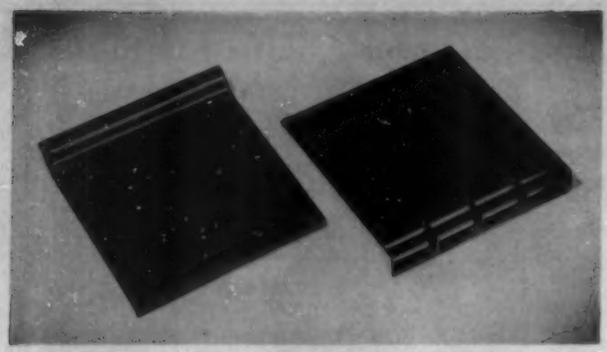
MOLD SHEDDING: This characteristic is exceptionally good. A surprisingly small quantity of air is needed for maintaining a clean mold. The rigidity of parts when extracted from mold is good.

FINISH: The finish of the molded parts depends, as usual, on the design and finish of the molds, aided by chilling when the need be. The texture can be varied from a leathery appearance to one which has a fairly high luster.

COLOR: Natural color of the molded parts is a dark, rich brown. Color ranges are possible in comparison to the phenolic molding material group.

MOLD CONDITIONS: Curing time is average for similar molding compounds, requiring in some instances a slightly longer cure. This additional curing time when necessary will probably be equalized by better shedding qualities and easier mold cleaning. Molding pressures are from 2000 to 5000 lbs. per sq. in., and the molding temperature is 350 deg. F.

(*Please turn to next page*)



Experimental abrasion-resistant tiles molded from phenolic cottonseed hull plastic have a high luster without polishing

PHYSICAL AND ELECTRICAL PROPERTIES OF "PLASTONE" (as furnished by Dr. Rosenthal):

Physical and electrical properties

Grams per cu. in. of molding compound	22.5
Bulk factor of molding compound	2.1
Specific gravity of molded material	1.39
Mold shrinkage, in per in.	0.008
Flexural strength, lbs. per sq. in.	10,490
Impact strength, ft. lbs. per in. of notch, Izod	0.29
Thermal conductivity in B.T.U. per deg. F. per sq. ft. per hour, per in. of thickness	$1.18 + 0.0004\,(\Delta T)$[a]
Breakdown voltage, volts per mil (maximum)	280
Arc resistance, number of arcs of 0.25 sec. duration to render surface conducting (maximum)	8
Dielectric constant:	
10^3 cycles	15.1
10^5 cycles	8.1
10^6 cycles	7.4
Power factor:	
10^3 cycles	.30
10^5 cycles	.12
10^6 cycles	.08
Surface resistivity (in ohms)	16×10^{11}
Volume resistivity (in ohm-cm.)	7×10^{11}
Water absorption, percent (48 hours)	0.75

Casters, cosmetic powder boxes, bushings, pointers and closures, which have been produced from this material show the versatility of the material.

Tiles (Fig. 3) are as they came from the mold, except for flash filing. A number of firms are cooperating to produce a coating finish for these tiles in many and various colors which will withstand abrasion.

Continued progress in the development of this phenolic cottonseed hull molding compound will not only utilize an agricultural by-product that has heretofore been of no particular use, but will also permit new uses for plastics in lower priced molded material brackets.

[a] Morton, R. W., *Mechanical Engineering*, Oct. 1940, p. 734.

Evolution of safety glass

(*Continued from page 38*) therefore, a thickness not much greater than that of the solid glass formerly used.

A mechanically safe pane could be made of plastic alone, and such panes are in general use in aircraft. But this has never been found feasible in land vehicles, because no organic plastic yet made will resist the abrasive action of sand, dust and cleaning compounds. For this reason the plastic is faced on both sides with glass, which contributes the necessary hard surface and yet is not so thick as to be unyielding under the impact of an accident.

In this same connection there arises the question of the difficulty of escape from a closed car by breaking through the glass. A plain glass windshield or window, if it has not already been broken by the accident, can, of course, be smashed by a blow, but jagged pieces remain held by the frame and must be carefully pulled out if a person is to pass through the space without being badly cut. With modern laminated glass, escape is easier. A heavy blow will crack the glass, but all the fragments remain adhering to the interlayer, and a strong pressure upon the bulging pane will push it out of the frame in one piece, leaving the entire opening of the frame clear for escape.

Safety glass for special purposes

For certain special purposes, safety glass is made in special forms not necessarily suited to use in ordinary vehicles. For example, a heavy composite, which may comprise more than one interlayer and more than two sheets of glass, is designed for protection against bullets, and a composite of a relatively heavy interlayer with two sheets of "hardened" glass is designed to withstand the bursting pressure within an airplane flown at very high altitudes.

To meet present-day standards, a safety-glass interlayer must be free from haze, and substantially colorless and clean. It must be capable of being bonded firmly to glass. It must be tough and extensible, in order to provide the desired "rubber-bag break." This toughness and extensibility, and the strength of the bond between interlayer and glass, must be adequate at all temperatures of service, so that the protective character of the composite pane will not be impaired by embrittlement in cold weather nor by softening at summer temperatures. It is essential also that none of the desirable characteristics of the composite be impaired by age or by prolonged exposure to sunshine. And the interlayer itself and its bond to the glass must not be subject to impairment by moisture, which would necessitate sealing of exposed edges of the pane.

Polyvinyl interlayers

The displacement of cellulose nitrate by cellulose acetate constituted a step forward toward meeting these severe requirements. And now cellulose acetate itself has been very largely displaced for this use by a

synthetic resin, one of the group known chemically as the polyvinyl acetals. The resins of this group are formed by polymerizing a vinyl ester (usually vinyl acetate), hydrolyzing this more or less completely to polyvinyl alcohol, and effecting a condensation of polyvinyl alcohol with an aldehyde.

The characteristics of these resins are influenced by various factors which are subject to control in the course of their manufacture. The viscosity, or molecular size, is controlled by the conditions under which the vinyl ester is caused to polymerize. A second variable is the extent to which hydrolysis of the polyvinyl ester is allowed to proceed; the percentage of unaltered polyvinyl ester in the final resin influences the solubility of the latter, its compatibility with plasticizers and its sensitivity to water. A third means of influencing the character of the ultimate resin is found in the selection of the aldehyde with which the polyvinyl alcohol is caused to react; for making safety-glass interlayer the resin used is that produced by interaction of polyvinyl alcohol with butyraldehyde, and hence called polyvinyl butyral resin. A fourth means of control of the characteristics of the product lies in the extent to which the reaction of condensation is allowed to proceed, which determines, of course, the relative percentages of polyvinyl alcohol and polyvinyl butyral in the ultimate resin, which in turn influence the solubility and compatibility of the resin.[9]

With these means at hand for controlling the characteristics of the resin, it has been possible to work out a procedure by which to produce that particular resin which, among all the possible resins of this group, offers the best combination of properties for the purpose. This task, and the further problems of working out details of procedure and equipment on a large manufacturing scale, required, of course, large expenditures of time and money for research. And paralleling the research on the resins themselves there has been a continuous program of research on plasticizers, for the selection and proportioning of the plasticizer is a very important factor in the results achieved.

The plasticizer must be properly compatible with the resin, and it must be free from color and from discoloration or other deterioration during the period of service of the product. A suitable plasticizer used in proper proportion enhances the desirable mechanical characteristics of the resin itself and makes it possible to achieve the desired "balancing" in the characteristics of the resulting interlayer so that it will be entirely satisfactory at all temperatures of service.

This great expenditure of money has been found well justified by its results. The polyvinyl butyral resin interlayer is definitely superior to its predecessor, the cellulose acetate interlayer, just as the latter was superior to the pyroxylin interlayer. The cellulose derivatives were characteristically and inevitably lacking in complete clearness, but the resin, being made from filterable or distillable liquids, under conditions which avoid contamination, is perfectly free from haze. And in toughness and extensibility, and in the per-

sistence of these necessary characteristics at all temperatures of service, the polyvinyl butyral is very clearly superior to the cellulose acetate.

In a period of about two years the polyvinyl butyral interlayer has progressed from experimental acceptance to the point of being used practically to the exclusion of all other interlayer materials. Specifications for the material have become established and generally accepted, and the manufacturers know how to control their processes to meet these specifications. The technique of working up the resin, with plasticizer, into continuous sheeting has been established by suitable modifications of the technique already developed for the manufacture of sheetings of pyroxylin and of cellulose acetate by extrusion.

The industry is, at the moment, in a condition of comparative stability. But research departments are not overlooking the possibilty that something else may be found which is better even than the polyvinyl butyral resin. If and when such a new material is found, and if it has sufficient in its favor to warrant the expense of its development to replace polyvinyl butyral, then that further step of progress will inevitably be taken, to the benefit of the motoring public.

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[1] Bodenbender, "Sicherheitsglas" (Berlin, 1933), p. 1.
[2] Ibid., p. 182.
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[4] Encyclopaedia Britannica (14th ed.), vol. 10, p. 42.
[5] Glaces et Verres, *3*, No. 18, p. 9 (1930).
[6] Ibid., p. 10 (partial translation).
[7] Helvetica Chimica Acta, *12*, 1112 (1929).
[8] J. Soc. Glass Technology, *16*, 78 (proceedings) (1932).
[9] Modern Plastics *16*, October 1938, p. 56.
[10] Safety Engineering, *44*, 95 (1932).
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[14] Cf. Celluloid Industrie, *30*, 1573 (1930); Chem. Abst., *29*, 3154 (1935).

London letter

RECENT British legislation by the Ministries of Labor and Supply with the object of cutting down non-essential imports, releasing skilled men for armament work and non-skilled men for the fighting services and also reducing public expenditure on luxury goods, has had serious repercussions on those branches of the plastics industry supplying moldings for toilet goods, cosmetics and fancy goods. True, the firms which were hit by this measure of industrial wartime economy are mainly small concerns, but in the aggregate they constitute an important section of the industry and one least able to adapt itself very readily to war work because of its limited financial resources. Again the capital tied up in special tools and presses needed for the mass production of bottle caps and closures, cosmetic requisites, fountain pen barrels and a host of small novelty lines represents a fairly considerable sum of idle money.

As a result of this enforced industrial inactivity there are now very few of these "luxury" plastic moldings in the shops and there is a risk of the public getting the opinion that plastics have gone out of favor through some inherent lack of quality. At present this is only a risk but it is one to bear in mind as likely to influence post-war orders when aluminum and other "verboten" materials will be readily available. It is very necessary that the public should be reminded that although plastics may have disappeared from the shops they are becoming increasingly common in the workshops. All the fighting services are now making new and continued demands on the resourcefulness and skill of the industry and plastics are being called upon to replace ferrous and

non-ferrous metals, ceramics, glass and wood to a degree which would have appeared incredible twelve months ago.

It must, of course, be remembered that the introduction of this new Act which stifles luxury and non-essential industries has made possible some entries in the credit side of the balance sheet. For instance, the migration of skilled and semi-skilled men from plants specializing in bottle caps and lipstick holders to those making vital electrical accessories is an advantage.

Another credit entry is the increase in the number of those firms molding much-needed articles for the national war machine, overseas trade or essential home market, such as battery cases. In some instances, factories which a few weeks ago were turning out large numbers of fancy bottle caps for well-known perfumers are now busy on small molded components for the Ministry of Aircraft Production. Tools previously used for luxury goods have even been ingeniously adapted for more vital moldings. Thus, in one case dies used for producing an expensive shaving stick container have been adapted to mold a pocket flashlight case. This remarkable metamorphosis in metal is, of course, only possible in a small percentage of cases, but more attention is being paid to possible transformation by firms anxious to reduce tool costs and also delay in starting production.

In previous correspondence no mention has ever been made of the valiant work carried on by the British Plastics press during the last six months of intense aerial warfare. It is something of which to be proud to know that the two journals dealing with the industry have never yet failed to appear on their publication dates and this in spite of times when the Blitz on London cut off all supplies of gas, electricity and water for several days at a time. Add to this the fact that traveling facilities were often very irregular after heavy raids on the capital and the staff could not arrive at the office until eleven or even twelve o'clock. Worthy of comment is the growing interest shown by industrialists in the literature dealing with all phases of the plastics industries. Publishers report increased sales of leading texts.

The new Government campaign designed to make the British people gas conscious so as to be prepared should this new horror be loosed on us from the skies calls into action more plastic goods. The demands for the cellulose acetate eyeshields is now phenomonal and some firms are concerned almost solely with their production. These shields are recognized as being highly efficient in protecting the fighting services from gas spray, particularly mustard or Lewisite which comes down in the form of tiny droplets. It is predicted that more use will be made of plastics for A. G. (anti-gas) articles of equipment as both thermosetting and thermoplastic surfaces are not penetrated by war gases and may very easily be decontaminated. Thus once again the plastics industry is able to give valuable assistance to the country in the time of national emergency. (*Mailed April 21, 1941, Mrs. John S. Trevor.*)

In the limelight

(*Continued from page 82*)

★ THE OFFICE OF PRODUCTION MANAGEMENT Division of Priorities on May 1st expanded the Priorities Critical List to include synthetic resin molding powders and other products which affect plastics. Among them are included acetone, anhydrous ammonia, autoclaves (laboratory), chemicals; chemical warfare; explosives, chromium, power driven compressors, cotton linters, cresols, cresylic acid, formaldehyde; Halowax solution for insulating wire, iron and steel products including alloy steels, methanol, nickel, phthalic anhydrite and thermometers. The Priorities Critical list is a compilation of items on orders for which the appropriate Army and Navy representatives may issue preference rating certificates automatically. Procurement officers and inspectors may also assign preference rating certificates on subcontracts for these items, subject to regulations set forth in the War and Navy Department instructions. The list is subject to revision once each month.